Government of the People's Republic of Bangladesh
Bangladesh Water Development Board
Flood Plan Coordination Organisation

FLOOD ACTION PLAN

NORTHEAST REGIONAL WATER MANAGEMENT PROJECT (FAP 6)

PROJECT MONITORING PROGRAMME SHANIR HAOR FCD PROJECT (1992-94)

Draft Final

October 1994

SNC ♦ Lavalin International
Northwest Hydraulic Consultants

in association with

Engineering and Planning Consultants Ltd.
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Nature Conservation Movement

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ACRONYMS AND ABBREVIATIONS

BADC	Bangladesh Agriculture Development Corporation
BFRSS	Bangladesh Fisheries Resources Survey System
BWDB	Bangladesh Water Development Board
CAS	Catch assessment survey
CBM	Community-based management
CIDA	Canadian International Development Agency
CPUE	Catch Per Unit Effort
DAE	Directorate of Agriculture Extension
DLS	Directorate of Livestock Services
DOF	Department of Fisheries
DOFr	Department of Forestry
DPHE	Department of Public Health Engineering
DRH	Department of Roads and Highways
EIP	Early Implementation Project
EPI	Extended Programme for Immunization
FAP	Flood Action Plan
FCD/I	Flood control and drainage/irrigation
FRI	Fisheries Research Institute
FFW	Food for Work
GOB	Government of Bangladesh
GPS	Global Positioning System
HYV	High yielding variety
IDA	International Development Association
KSS	Krishi Samabaya Samity, BRDB-sponsored farmers' cooperative society
LGED	Local Government Engineering Department
LLOP	Lowest level of plantation
LLP	Low Lift Pump
Mt	Million tonnes
MFL	Ministry of Fisheries and Livestock
MIWDFC	Ministry of Irrigation, Water Development and Flood Control
MLGRDC	Ministry of Local Government, Rural Development and Co-operatives
MOC	Ministry of Communication
MOL	Ministry of Land
MPO	Master Plan Organization
NERP	Northeast Regional Project
NFMP	New Fisheries Management Policy
NGO	Non-government organization
PMP	Project Monitoring Program
PWD	Public Works Department (survey datum)
SHP	Shanir Haor FCD Project
SOB	Survey of Bangladesh
SRP	Systems Rehabilitation Programme
WFP	World Food Programme

YEAR 1: May 1992 to April 1993

YEAR 2: May 1993 to May 1994

GLOSSARY OF TERMS

aar	Homestead protection using earth, wild plants and bamboo
aaratdar	Trader with a space for storing commodities
abadi	Settler from outside (Sylhet)
akai	Gleaning of submerged rice
aman	Monsoon rice crop harvested in November/December
bajail	A kind of wild grass
barga	Share cropping
baribandha	A barrier which protects the homestead platforms from erosion due to wave action during the floods
barman	Hindu sub-caste whose major profession is fishing
barki	Persons engaged in collection and trading of sand and boulders
beel	Shallow lake
bepari	Harvester of boro rice who generally comes from outside the area.
bhagi	Share cropping
bhasha	One type of fishing method
bigha	Local unit of land measurement (one bigha = 0.13 ha)
bisra	Area adjacent to homestead and intermediate in height between homestead and rice fields, on which vegetables are grown
biyash	A tree species used as fuelwood
boro	Rice grown in the dry season and harvested in April/May
borun	A tree species used as fuelwood
chailla	A long grass grown in low land (*Hematheria potensa*)
chanda	Contribution
changari	Platform, especially made to dry fish
chhon (ululbinna)	A grass used to thatch house roof
chorergaon	Thief village
chukti	Seasonal lease of agricultural land with an agreed fixed amount of the produce to be paid after the harvest.
chula	Cooking place (oven)
dair/chhit	Terrace of shallow channel within rice field
dalal	Commission agent
debata gach	Tree symbolizes god/goddess
deta	Rice straw
dhara	Bamboo mat
dhenki	Manually operated rice husking machine
doba	Smaller water body
don	An indigenous method of manual irrigation
durba	A kind of grass
ejmali	Jointly owned by co-sharers/villagers
erali	A kind of wild grass
firal	A person who claims himself spiritual to protect boro rice from hailstorms
gola	Granary
haal	Local unit of land measurement (1 haal = 12 ker = 1.44 ha)
haor	River back swamp

hati	Continuous group of homesteads occupied by a social group sharing lineage and/or other factors.
hizol	A tree species used as fuelwood
ikor	A tree species
jagli	An indigenous variety of boro rice
jala	Seedings
jalachar	Seedbed
jalmohal	Fishing ground
jangal	Dike-cum-road across crop fields
kai/singra/pukal	Various water chest nuts
kaiborta	Hindu sub-caste whose major profession is fishing
kamla	Wage labourer
kanda	Ridges that are higher than the haor basin but lower than homestead land.
katha	Branches of trees or bamboo piles placed in water to provide shelter for fish.
ker	Local unit of land measurement (one ker = 0.12 ha)
khal	Small drainage channel
khalashi	Sluice gate operator
kharif	Monsoon crop season, including the Aus and Aman crop
khas	Government-owned land.
khet	Agricultural land
khola fura	Collection of left-over rice from threshing ground.
khola	Drying space next to the homestead/ temporary fishing shed
kona jal	A kind of fishing net
koroch	A tree species used as fuelwood
kossom	Buried tree, partly decomposed
lepa	Smearing a mixture of cow dung, soil, and water
mahajan	Local money/rice lender
maimol	Muslims whose major profession is fishing.
majhi	Boatman
maund	Local unit of measurement (one maund = 37.5 kg)
mehagani	A tree species with high timber value
mera	A tree species used as fuelwood
namasudra	Hindu sub-caste with low status
nara	Rice straw
nikari	Fish retailer
nojorer bou	A wife married legally, but not accepted by the family.
nolkhagra	One type of wild plant used for homestead protection
paharadar	Guard
parishad	Council
patam	Wooden platform of boat
patni	Hindu sub-caste whose major profession is boat plying
paura	A kind of wild grass
pon pratha	Dowry system
purdah	Seclusion
rabi	Dry season
rangjama	Seasonal lease of agricultural land with an agreed advance in cash
samity	Cooperative society

sampad	Resource
shail	A variety of boro rice
shak	Leafy vegetable
shutki	Dry fish
singra	A type of water chest nut
sinthal	A special kind of dry fish
sona bang	A frog species
tab	Bamboo poles to provide fish shelter
thana	Smallest administrative unit; below district (formerly upazila)
ujaiya	Movement of fish against water current
union parishad	Local government council at union level
uthan	Courtyard
zamindar	Feudal landlord
zirati	Immigrant cultivators

Calendar conversion

Bangla calendar	International calendar From middle of-	To middle of
Baishakh	April	May
Jaishthya	May	June
Ashar	June	July
Sravan	July	August
Bhadra	August	September
Ashwin	September	October
Kartik	October	November
Agrahayan	November	December
Poush	December	January
Magh	January	February
Falgun	February	March
Choitra	March	April

NERP DOCUMENTS

Documents prepared during Phase I of the Northeast Regional Water Management Project include the following:

Northeast Regional Water Management Plan

Main Report
Appendix: Initial Environmental Evaluation

Specialist Studies

Participatory Development and the Role of NGOs
Population Characteristics and the State of Human Development
Fisheries Specialist Study
Wetland Resources Specialist Study
Agriculture in the Northeast Region
Ground Water Resources of the Northeast Region
Surface Water Resources of the Northeast Region
Regional Water Resources Development Status
River Sedimentation and Morphology
Study on Urbanization in the Northeast Region
Local Initiatives and People's Participation in the Management of Water Resources
Water Transport Study

Public Participation Documentation

Proceedings of the Moulvibazar Seminar
Proceedings of the Sylhet Seminar
Proceedings of the Sunamganj Seminar
Proceedings of the Sherpur Seminar
Proceedings of the Kishorganj Seminar
Proceedings of the Narsingdi Seminar
Proceedings of the Habiganj Seminar
Proceedings of the Netrokona Seminar
Proceedings of the Sylhet Fisheries Seminar

Project Monitoring Programme

Manu River Irrigation Project
Shanir Haor FCD Project

Pre-feasibility Studies

Jadukata/Rakti River Improvement Project
Baulai Dredging
Mrigi River Drainage Improvement Project
Kushiyara Dredging
Fisheries Management Programme
Fisheries Engineering Measures
Environmental Management, Research, and Education Project (EMREP)
Habiganj-Khowai Area Development
Development of Rural Settlements
Pond Aquaculture
Applied Research for Improved Farming Systems
Manu River Improvement Project
Narayanganj-Narsingdi Project
Narsingdi District Development Project
Upper Kangsha River Basin Development
Upper Surma-Kushiyara Project
Surma Right Bank Project
Surma-Kushiyara-Baulai Basin Project
Kushiyara-Bijna Inter-Basin Development Project
Dharmapasha-Rui Beel Project
Updakhali River Project
Sarigoyain-Piyain Basin Development

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APPENDICES

1. PROJECT MONITORING PROGRAMME

1.1 General Programme Objectives and Approach

The central objective of the Project Monitoring Programme (PMP) is to create a basis for improved water resources planning and design through better understanding of the real impacts of actual FCD/I projects. Monitoring refers to ongoing, periodic observation and analysis of parameters in order to characterize, where possible quantitatively, the impacts on agronomy, fisheries, environment, socioeconomics and other sectors/disciplines of an FCD/I project.

PMP is designed to help achieve a better understanding of the livelihood pattern of the people of the area, and the impact of the project on it, and hence determine the needs for, and means of achieving institutional and technical improvements in FCD/I projects at the planning, design, construction, operation and maintenance levels.

The objectives and activities of PMP are conditioned by a certain philosophical approach to development which has the following salient postulates:

- The dynamics of rural life should be understood before starting any viable planning for the betterment of rural society.
- Development is a process which should not be imposed from outside.
- Area residents probably know best how to cope with situations affecting them, while outsiders can best act as 'catalysts' using their knowledge and expertise to stimulate the local population to initiate activities - especially those involving novel methods and approaches.
- The environment of the residents (village, haor, surrounding rivers) of a particular project needs to be well understood before advocating any remedy.
- Emphasis should be given to human populations - their experiences, perceptions and practices.
- Infrastructure development should follow people's needs.

The PMP approach has as its primary focus the welfare and livelihood of people living in and around the project area. Socioeconomic monitoring encompasses the impacts on humans of all technical disciplines. For technical parameters, PMP adopts a system analysis approach, complemented by time trend analysis. As historical statistical data is limited to that which is available from pre-feasibility and feasibility reports, and recall data from interviews can lack quantitative precision and reliability, the systems analysis approach (modelling) possesses advantages for understanding how a haor landscape modified by an FCD/I project functions, and how the human population living in and around the haor responds technically, economically and socially to the modified environment created by the FCD/I structures. As an extension of the system analysis approach, the information collected can be used to construct a predictive model that can have utility in feasibility studies of proposed modifications to the existing project, and to proposed projects elsewhere.

1.2 Selection of Project for Monitoring

PMP monitored two FCD/I project in the Northeast Region - one partial flood control project in the deeply flooded area, and one full flood control project in the moderately flooded area. All partial flood control projects in the region were assessed for their suitability as PMP sites. Shanir Haor FCD Project (SHP) was selected based on the following five factors and attributes:

- The haor has been impacted by embankment-cum-regulator FCD infrastructure since the 1920s, and therefore it was expected that FCD impacts have already gone through a long term evolution. This gives the site a greater pedagogical value as compared to more recently constructed FCD projects. If it is hypothesized that FCD projects tend towards stability of benefits and impacts over the long term, such a tendency should be apparent at SHP.

- The haor is regarded as the deepest in the area. Accordingly, flood effects on production sectors (agriculture, livestock, fisheries, forestry, natural wetlands products) and human settlements/infrastructure should be more exaggerated/severe than at other project sites. FCD infrastructure (including maintenance and operation) would also be expected to come under more rigorous use/testing than elsewhere.

- The haor is known to contain significant fisheries. As fisheries in particular are known to suffer adverse effects from FCD projects, SHP represents a good opportunity to study FCD impacts on this vulnerable sector.

- The haor population is ethnically (Hindu/Muslim) and occupationally (farmers/fishermen) mixed, and therefore represents a diversity of human interests against which FCD impacts could be gauged.

- The haor is remote from social infrastructure (hospitals, higher education institutions, roads, electricity, telecommunication). It is generally postulated that FCD projects in the deeply flooded area act as primary infrastructure interventions which create the conditions that attract and make possible the second order level of social infrastructure. SHP therefore represents a good example for assessing the degree to which FCD projects can act as prerequisites for, or catalysts of, further enhanced development. The long 70 year history of SHP as an FCD site adds to its suitability as a model to test this postulate.

1.3 Specific PMP Objectives

Social: To evaluate the impacts of the project on human development and standard of living (employment and disposable income; literacy and education; health, nutrition and life expectancy; public empowerment, economic equity, gender equality and freedom).

Economic: To evaluate the impacts of the project on production sectors (agriculture, fisheries, forestry), services (navigation, health, education, communications) and infrastructure (roads, domestic water supply, energy supply).

Physical: To evaluate the physical performance and physical impact of the project inside and outside the project area.

Financial: To assess the economic efficiency of the investment of the project in terms of internal rate of return, benefit/cost ratio and net present value.

Operational: To attempt to construct a system model of the project which can simulate behaviour of key hydrological and operational variables and generate robust predictions of their impacts on discrete physical, socioeconomic and other functions within and around the project area.

Planning: To formulate practical recommendations to solve FCD-induced and related problems in the project impact area.

1.4 Methodology

Field monitoring was conducted from May 1992 to May 1994. This period included two hydrologic years, the first relatively dry and the second having two major floods (almost the highest on record). The following parameters were monitored:

- water levels inside and adjacent to the project area;
- river morphology and sedimentation;
- engineering design, operation, and performance of the project;
- fisheries habitat, environment, migration, fishing practices, and production;
- agricultural practices and production;
- societal indicators (social, economic, social interaction, and human dynamics).

The monitoring relied heavily on direct observations and extensive interviews with local people. These observations were supported with direct quantitative measurement wherever possible (water levels, agricultural production, crop areas, fish counts, and fisheries production). Published data on water levels and discharges, agricultural production, fisheries production were compiled and analyzed to help determine the present conditions and the history of change within the project area. The monitoring and analysis were carried out by a multi-disciplinary team of specialists and other professionals.

Where inconsistencies in the data arose, which often happens with anecdotal information, these were resolved to the extent possible. The observations and other data were compiled, integrated, and analyzed to form a more complete understanding of the project impacts and to form this document.

1.5 Report Layout

A detailed description of Shanir Haor based on the above listed parameters is given in Chapter 2. Chapter 3 provides a brief over-view of the field programs for each of the NERP specialist teams involved in the PMP. A detailed description of the chronological events that occurred in Shanir Haor followed summary of the major events that occurred in the 2 year program is given in Chapter 4. More details of these events are available in the various appendices. Chapter 5

gives an evaluation of the project performance. Chapter 6 presents specific recommendations for Shanir Haor Project, while Chapter 7 gives recommendation for future partial flood control projects.

2. PROJECT DESCRIPTION

2.1 Location and Boundaries

Shanir Haor Project lies between longitudes 91°08'05"E and 91°12'23"E, and between latitudes 25°01'51"N and 25°06'45"N. It is situated about 320 km northeast of Dhaka, and about 125 km west of Sylhet. The project is reached by road from Sylhet to Sunamganj (65 km), and by boat from Sunamganj (20 km).

Administratively, the project lies within Sunamganj District and occupies the Beheli, Sripur South, Tahirpur, Balijuri and Fatehpur unions of Jamalganj, Tahirpur and Bishwamvarpur *thanas*. Tahirpur Thana headquarters is located at Tahirpur on the northern boundary of the project area.

2.2 Physical Environment

Topography

The whole region around Shanir Haor consists of *haors* which are large, saucer-shaped, seasonally-flooded inter-riverine depressions each within a perimeter of river levees. Shanir Haor is typical of these haors, most of which have been developed by raising submersible embankments on their river levees. Small water bodies known as *beels* occupy the lowest pockets within the haors. The beels are in contact with ground water in the underlying sediments and where the ground water table remains above ground level in the dry season the beels are permanent; otherwise they are seasonal and dry up in the dry season. Virtually all land in the area is below 8 m PWD, and it is flooded to depths of 5 m or more during the monsoon season. During the monsoon the rivers overtop the levees, and project embankments built upon them, and the whole region becomes a vast lake with only the villages and the highest stretches of levees and project embankments remaining above the lake water level.

Shanir Haor is situated in the Meghna Depression, a unique physiographical feature of Bangladesh. The Depression is a low-lying, bowl-shaped basin, covering about 6,000 km^2 and comprising about 25% of the Northeast Region of Bangladesh. It is by far the largest single inland depression in the country. Haors characterize the lowest part of the Depression where they are closely grouped together; this part is often referred to as the Haor Area. During the monsoon rivers flowing down from hills in the adjacent Indian states discharge huge volumes of water into the Depression, and for six to seven months of the year it takes the form of a vast lake.

Whereas the maximum land elevation in Shanir Haor is about 8 m PWD, and the land slopes upward to the north reaching about 25 m PWD at the foot of the Shillong Plateau (along the Indian border), the Plateau itself rises to a maximum elevation of 2,575 m near the town of Shillong. The southern slopes of the Plateau massif is thus very steep, slopes of up to 45° being common both opposite Shanir Haor and further east. The effect of these slopes is to force warm moist air approaching from directions between WSW and ESE, through S, to rise rapidly over the slopes. Cherrapunji, well known as the wettest place on Earth, lies on these slopes some 50 km northeast of Shanir Haor, and is the focus of a high rainfall area which extends over Shanir Haor and over the catchment area of the Jadukata River, the main river contributing to flooding of Shanir Haor.

The catchment area of the Jadukata is located entirely on the southern slopes of the Shillong Plateau. Runoff resulting from the heavy rainfall is rapidly delivered onto the alluvial fan of the Jadukata which extends from the foot of the Plateau down to, and including much of, Shanir Haor.

Historically, much of the Meghna Depression was densely forested and formed an important habitat for fish, waterfowl and other species. During the last two centuries the land use has changed to meet the needs of an ever-expanding human population. The forest has been consumed and in its place winter season rice, or *boro*, is now cultivated. Submersible embankments, intended to confine the rivers within their channels during pre-monsoon floods, have been constructed around many of the haors to protect the *boro* rice crop. Nevertheless, flash-floods coming from the Shillong Plateau to the north, particularly at the times of ripening and harvesting, often cause extensive crop damage even when there is no local rainfall.

Shanir Haor Project is roughly rectangular in plan being 13 km from east to west, and 6 km from north to south. The gross project area is 7,761 ha. The project area slopes from northeast to southwest, but the slope is not uniform and the project area falls naturally into four topographically distinct quadrants; the northeast quadrant contains the higher lands, the southwest quadrant the lower lands, and lands of intermediate elevation exist in the other two quadrants. The maximum elevation of agricultural land (about 6.8 m PWD) occurs east of Tahirpur, and the minimum elevation (about 0.9 m PWD) occurs near the Bogiani regulator. Higher land exists in the villages where the ground level reaches up to about 8 m PWD. There are several large beels in the project area: three - Sonatala, Chapti, Ramcharan and Bara Beels - are in the low-lying southwestern quadrant of the haor, the three Keuti Beels are in the southeastern quadrant, and three others - the two Kalya Beels and the Dhawa Beel - in the northeastern quadrant.

Geology and Soils

Geologically, the Northeast Region can be identified with the surface of a geological structure known as the Sylhet Trough, which is a down-warped region between the east-west oriented Shillong Plateau to the north and the north-south oriented Indo-Burman Ranges to the southeast. The Region is subject to subsidence as the result of ongoing subduction of the northward moving Indian Plate beneath the stationary Eurasian Plate. This subsidence is focused along the Dauki Fault which runs east-west along the northern border of the Northeast Region, and separates it from the Shillong Plateau. The relative displacement caused by down-warping of the Northeast Region, and over-thrusting of the Shillong Plateau along the Dauki Fault, appears to be of the order of 1,200 to 1,500 m.

The Northeast Region is seismically active and movements occur from time to time. More than 20 large earthquakes with epicentres in, or close to, the Region have been recorded in the last 180 years; four of these were of magnitude 7.0 on the Richter scale or greater.

Soils: The project area has predominately grey (or bluish grey), shallowly developed, clay soils in perennially wet basins, together with grey loams and clays on high river banks and small areas of peat in some basin centres. Grey piedmont loams and clays also occur in the project area. Texture ranges from silty clay loams to silty clays in perennially wet basin centre, silty clay to clay in basin soils, and loam to silty clay in ridge soils. Organic matter content ranges from 2-5% in perennially wet basin centre, 2-4% in basin soils, and 0.5-2% in ridge soils. Permeability is generally slow, except in some loamy ridge soils. Moisture-holding capacity is moderate in deep loamy ridge soils, but low in basin clays. In the dry season top soils becomes very hard

and widely cracked under unirrigated conditions. However, most soils stay wet because of irrigated rice cultivation in the boro season.

Climate

Shanir Haor has a typical sub-tropical monsoon climate characterised by the twice yearly reversal of air flow towards the Indian Subcontinent. The seasons in Shanir Haor are associated with the temporal pattern of this air flow as follows:

> Northeast Monsoon: During December through March the regional airflow is from the northeast; this period is usually referred to as "the dry season".
>
> Spring Reversal: In April/May the regional airflow veers from northeast, through northwest, to southwest.
>
> Southwest monsoon: During June through September the regional airflow is from the southwest; this period is usually referred to as "the monsoon".
>
> Autumn Reversal: In October/November the airflow veers from southwest, through southeast, to the north-east.

Locally, and near the ground, this airflow pattern is modified by the presence of the Shillong Plateau to the north, the Indo-Burman Ranges to the southeast and, during the monsoon, by the presence of a persistent low pressure area over northwestern India; the latter is particularly effective in deflecting the southwest monsoon wind westwards. As a result of these influences the local wind at the surface is generally between southeast and southwest throughout the year.

During the southwest monsoon moist air from the Bay of Bengal flows over the Northeast Region. Rainfall is abundant, increasing northeastwards and reaching a maximum on the south facing slopes of the Shillong Plateau where locally the mean annual rainfall may be as high as 12,000 mm. Along the northern border with India, the average rainfall during the southwest monsoon is a maximum of about 4,100 mm. The northeast monsoon is predominantly dry and the average rainfall is between 100 and 200 mm. During the spring and autumn reversals, average rainfall may be as high as 1,290 mm and 320 mm respectively.

Severe weather conditions usually occur during the spring and autumn reversals as distinct from the monsoon seasons when conditions are relatively stable. These severe conditions may comprise line squalls, known as nor'westers, and cyclones. Nor'westers are particularly prevalent in the spring reversal and are characterised by high winds, tornadoes, thunder and lightning, rain and hail. High winds and hail frequently cause extensive damage to standing crops and homesteads. Intense rainfall causes flash-floods which also result in crop damage, particularly to *boro* crops. Cyclones may occur during either the spring or autumn reversals, but since the Haor Area is some distance inland their impact on the area is not nearly as severe as in the coastal regions.

NERP's Analysis of rainfall data for 1901-90 indicated that the mean annual rainfall and the variability in rainfall has shown a gradual and accelerating increase. These results strongly suggest that the regional climate has been changing over the last 90 years and that the change is continuing at an accelerating rate. It is not known with any degree of certainty whether this

change represents a permanent rise to a new level of climatic activity, or whether it is merely the rise to a peak of some long term climatic cycle.

Maximum temperatures vary from about 27.6°C to 35.0°C with the highest temperatures experienced during the period April to June. There is a significant diurnal fluctuation with minimum temperatures ranging from about 9°C to 23°C.

The mean annual rainfall over the project area is about 5,765 mm. The rainfall exhibits a seasonal pattern with up to 75% of the annual total experienced during the monsoon period June to September. The period from December to March is significantly dry with less than 2% of the annual total.

Relative humidity is high throughout the year, with average humidity ranging from 65% to 89%. The humidity is highest during the monsoon period June to September. The average wind speed varies from about 2.0 to 2.5 m/s, the highest speeds occurring in between March and June. Potential evapotranspiration rates range up to 4.9 mm/day during the pre-monsoon month in April, and down to 2.6 mm/day in December and January.

Hydrology

The surface water hydrology of the Meghna subregion is controlled by its principal rivers, the Surma, Kangsha, Baulai and Kushiyara which discharge into the Meghna just upstream of Bhairab Bazar and drain most of the Northeast Region. These rivers have vast catchments outside Bangladesh totalling over 45,000 km^2 in the adjacent Indian States of Meghalaya, Assam, and Tripura. These catchments contribute over 60% of the average total water supply to the Meghna subregion.

Flows in the rivers draining the highland catchments in Meghalaya and Tripura occur as devastating flash-floods which typically rise to a peak in a few days at most and recede almost as rapidly. There is little attenuation of these floods within Bangladesh until they enter the main river system.

Among these rivers it is the Jadukata which directly affects Shanir Haor. This river carries the discharge from the largest catchment in Meghalaya, entering Bangladesh at Saktiarkhola. Flash-floods originating in Meghalaya flow towards the project area mainly through distributaries of the Jadukata River during the pre-monsoon season.

River Morphology and Sedimentation

Shanir Hoar, situated partially on the alluvial fan of Jadukata River, is in a morphologically unstable location that is subject to high intensity floods and large sediment inflows. Huge quantities of silt, sand and gravel are deposited along the rivers course and over agricultural land where overbank flow occurs. The Jadukata, which has produced the largest alluvial fan in the Northeast Region, is the main influence on flow patterns in the rivers around Shanir Haor. Preliminary sediment budget estimates indicated the river is probably transporting the highest sediment loads of all Meghalaya streams, in the order of 5 million tonnes per year. During the two years of discharge measurements at Saktiarkhola in 1990 - 1991, flows of up to 5,000 m^3/s (double the highest flood of record on the Surma River at Sylhet) have been recorded.

Gravel and cobble-sized sediments are deposited within a few kilometres of the fan apex near the Indian border. These sediments are quarried from the upper Jadukata River by local contractors

and gravel mining operators. NERP estimated (see appendix B) that the total sediment removed per year would be about 130,000 m^3. There is no evidence to suggest that the rate of extraction exceeds the incoming supply (the river is not degrading).

The evolution of Shanir Haor has been governed largely by the history of channel shifts and avulsions on the Jadukata River. James Rennell's 1768 map shows that Shanir Haor and the Nandia connecting the Baulai and Rakti Rivers did not exist at that time. The Jadukata River was divided into two channels - a western branch that headed south-west into the Baulai and a second channel that headed southwards into the Rakti and then into the Surma River. Maps from 1952 show the Jadukata flowed southwards in a wide braided channel until it split into the Baulai and Rakti Rivers at the northeast corner of Shanir Haor. The Rakti split again into the westward flowing Nandia, while a southern branch continued on towards the Surma River. Since this mapping, the Jadukata has experienced at least one avulsion near the bifurcation of the Baulai/Rakti. Ongoing sand deposition has virtually infilled the upper part of the Baulai and therefore all the low flow now passes down the Rakti. However, this channel has also experienced aggradation in recent years. The Jadukata has recently started a new avulsion just below the fan apex into the Moharram River. This avulsion will divert most of the flow and sediment into Matian, Tangua and Gurmar Haors and then into the lower Baulai River. After this avulsion the Rakti and Nandia will become virtually dead channels. These changes will significantly alter the flow regime of the northern part of the Sunamganj Haor Area.

2.3 Project Infrastructure

Project History

The very earliest development of flood protection projects in the Haor Area were undertaken early this century by local *zamindars* who attempted to protect low-lying lands within the haors from pre-monsoon flash-floods by constructing small submersible embankments at vulnerable points. There was little further development of flood control projects in the Haor Area until 1975 when a marked increase in development took place which has continued into the 1990's. Overall development of the Haor Area was outlined in the Government's 1964 Master Plan. This plan, however, dealt primarily with flood control development based on non-submersible type embankments.

The development of Shanir Haor dates back to the 1920's when, according to local farmers, about 19 km of submersible embankment, and an 8-vent regulator with 1.5 m x 1.8 m vents, were constructed by a local *zamindar*. The embankment was tied into the higher river levees along the northern side of Shanir Haor, and the regulator was constructed on Bogiani Khal. The regulator featured a concrete base, brick piers and steel gates. The regulator eventually became inoperable, possibly due to siltation at the gates; eventually the gates were removed and subsequently a cross-dam was built on the *khal* every year to close it.

BWDB took over development of Shanir Haor in 1976 incorporating it in the Haor Development Programme of its Sunamganj Division. The present 50 km submersible embankment was constructed under the Food for Work (FFW) program between 1976-77 and 1979-80. Between 1980-81 and 1985-86, a new regulator was constructed (work was intermittent) under IDA credit. The project was declared complete in 1986, and since then BWDB has carried out maintenance of the embankment under FFW.

Neither feasibility study nor design documents are available for the project. The project is included in the Master Plan for Development in Haor Areas, Directorate of Planning Feasibility Studies, BWDB, Dhaka 1982, and Early Implementation Projects (EIP) produced a Draft Report on Operation and Maintenance (BETS and Kranti Ltd) in 1990. The Shanir Haor Project embankment was surveyed by SRP-Halcrow in March 1993.

Shanir Haor Project as implemented in 1985-86 consisted of the following components:

- A submersible embankment around the periphery. The total length around the perimeter of the project is approximately 50 km.
- A 6 vent regulator with 1.55 m x 5.53 m vents on Bogiani Khal replacing the old 8 vent masonry regulator.

Subsequently the following additional works were carried out:

- Five compartmental bundhs with a total length of about 23 km were constructed within the haor.
- Twenty-three pipe sluices were constructed in the compartmental bundhs for drainage of the compartments.
- Fourteen bridges, box culverts and open foundation culverts were constructed by *thana* authorities in the embankment on the northern boundary of the project.

Project Concept

The Shanir Haor Project is designated as a Flood Control and Drainage (FCD) project, meaning that irrigation was not included in the original project concept. The project concept, like that of all the other haor projects, is to provide flood protection for the main crop, *boro*, against pre-monsoon flash-floods in the surrounding rivers by means of a submersible embankment around the haor, and to enable drainage of the haor in the post-monsoon season by means of a drainage regulator. The regulator also serves to flush water into the project before pre-monsoon overtopping of the embankment so as to reduce the head difference across the embankment, and so reduce erosion damage to it. The regulator is also used to retain some water in the haor in the post-monsoon period for irrigating.

The engineering infrastructure has not provided the expected benefits due to the inadequate number and design of regulators in the embankment for flushing and drainage purposes. As a result the public resort to cutting the embankment for the purpose of letting water into and out of the project area.

Flood Embankment

A submersible flood embankment (the project embankment) extends along the banks of the Baulai, Rakti, and Nandia Rivers entirely enclosing Shanir Haor. The project embankment connects village mounds where ground levels are generally higher than the project embankment design crest level, given as 6.10 m PWD. The total length of the project embankment (village mounds included) is 50.5 km. The project embankment design side slopes are 1:2 on both the river and haor sides, and the design crest width is 6 m.

SRP-Halcrow's March 1993 engineering survey of the project embankment shows that most of it is above the design crest level especially along the north and northeast sides of the project area where its general level is above 7 m PWD. Along the western and southern sides of the project

area, however, the project embankment is generally below the design crest level. Conformance to the design crest width and side slopes is rarely attained.

Erosion of the embankments occurs due to overtopping, and to wave and river current action. Along the Baulai, from Subla to Monsurpur near Tahirpur, a length of about 6 km is subject to wave action on water retained inside the haor, and much of this length has been protected on the haor side by stone pitching and a retaining wall.

Compartmental Bundhs

There are five compartmental bundhs with a total length of about 22.7 km, and a design crest width of 2.4 m. The bundhs run between:

Bundh 1:	Ekrampur and Tahirpur
Bundh 2:	Tahirpur and Radhanagar
Bundh 3:	Ramcharan Beel to Rajendrapur
Bundh 4:	Bara Beel and Radhanagar
Bundh 5:	along the Nandia River

Bundhs 1, 2 and 3 were constructed by local farmers but are now maintained by BWDB; they are reported to have a design crest level of 4.1 m PWD. Bundhs 4 and 5, with a total length 6.9 km, were constructed by BWDB, and have a design crest level of 6.1 m PWD; these two bundhs are in fact more in the nature of retired sections of the project embankment, and have the same design crest level.

The objective of the compartmental bundhs is to divide the haor into suitable compartments for retaining water at different levels for irrigation in the dry season.

The bundh 1, from Ekrampur to Tahirpur, is badly damaged and local farmers request its rehabilitation. A total of 19 public cuts or breaches in bundhs 1,2 and 3 were identified during the SRP-Halcrow engineering survey of March 1993.

Drainage Channels

The project area is naturally drained by a number of *khals*, notably the Ahmokkhali, Bogiani and Beheli Khals. Many of these *khals* were closed when the project embankment was constructed, and it was expected that drainage of the project area would be principally through the Bogiani Khal and Regulator on the south side of the haor. Drainage congestion is reported to be severe around the Bogiani Regulator.

Bogiani Khal drains the Sonatala, Bankoi, and Ramcharan Beels, and other low-lying areas in the southwest, into the Nandia River. Radhanagar Khal, which is closed by the embankment, also drains this area when the embankment is cut. Similarly, Ahmokkhali Khal, which used to be the main drainage outlet for Chapti Beel, and Ramjibanpur Khal are also closed by the project embankment and can only function when they are cut. Beheli Khal forms the main drainage channel for the southeastern part of the haor, including Dhawa and Kalya Beels, through a public cut to the Nandia River.

A network of small drainage channels connecting the beels and other low-lying areas inside the haor exists but is said to be in poor condition. Farmers often complain that these small canals need to be dredged to improve the internal drainage of the haor.

Regulator
The Bogiani Regulator is a 6 vent (each vent 1.55 m x 5.53 m) structure situated at the outfall of Bogiani Khal in the southwest part of the haor; this is the only regulator in the project area. The Regulator is supposed to provide drainage and flushing of the whole project area. It is in good structural condition. Its invert level is 1.11 m PWD.

The Bogiani regulator is provided with wooden stoplogs which have to be inserted to the full height of the openings (5.53 m) from the operating deck. Insertion and extraction of the stoplogs is very difficult and unsatisfactory when any appreciable differential head occurs across the regulator; often the stoplogs cannot be removed. The stoplogs leak badly and the farmers request replacement with vertical lift gates. The drainage capacity of the regulator is reported to be insufficient.

Drainage Outlets
There are 21 drainage outlets located in compartmental bundhs 1, 2 and 3. The outlets are each laid on a cement concrete foundation base. There is provision for water control and regulation by means of fallboards. The condition of the outlets is generally good, except three which were noted to be in poor condition during the SRP-Halcrow 1993 survey. Besides the 21 drainage outlets, there are four other structures built in the compartmental bundhs without any concrete base or headwalls.

Irrigation Inlets
There are no irrigation inlets in the project embankment. The Project Proposal submitted by BWDB states that 13 low-lift pumps (LLPs) operated in Shanir Haor in 1990/1991; these were operated beside cuts made by farmers in the project embankment. Information from *thana* records shows that there were 24 LLPs operating in 1992; the target area for these was 437 ha, but the actual area irrigated was only 360 ha. BWDB propose construction of 20 irrigation inlets at various locations along the project embankment, the exact locations to be decided in consultation with the farmers.

Roads
There is no motorable road into, or within, the project area. There is a dry season village road in the eastern part of the haor linking Tahirpur with Sunamganj via Bishwamvarpur, and with Jamalganj. The road runs along some portions of the project embankment, particularly the high section between Tahirpur and Hashempur. This road leaves the project area at Fatehpur where it is necessary to cross the Nandia River by boat or by wading. Several other rivers including the Rakti and Surma have to be similarly crossed before Sunamganj is reached. Road traffic consists primarily of pedestrians with only the occasional bicycle or motorcycle.

The project embankment often serves as a tow path for country boats. The compartmental bundhs are used in the dry season by pedestrians travelling through or in the haor, and by farmers to reach their fields.

Bridge and Culverts
There are 12 bridge and culverts located in the project embankment along the Baulai and Rakti Rivers, and another two culverts located on the short road through the hoar between Hashempur to Anwarpur. All these structures are the responsibility of the *Thana Parishad*. The openings at these structures allow local drainage out of the haor, and it is reported that they do not cause

flooding of the haor since local farmers close the openings during the pre-monsoon season by means of temporary earth bundhs.

2.4 Human Population and Natural Resources

Population Characteristics

According to the 1991 census, the total population inside Shanir Haor is 24,674 (12,768 male and 11,906 female). The average size of household is 6.39 which is higher than the national average of 5.48 and the average for Sunamganj District of 6.06. The sex ratio is 107 males per 100 females which is also higher than that of Bangladesh (106), as well as that of Sunamganj district (105). According to a sample survey conducted in 1992, 84% of the population was found to be illiterate and agriculture is the predominant occupation of the male population.

The state of health care and education in the project area is poor. Diarrhoea and infectious skin diseases seem to be the major health problems. A high prevalence of malaria has also been observed. The area lacks adequate infrastructure for curative health care. In addition proper health education and access to safe drinking water are needed to prevent some of the common diseases.

People generally drink tube-well water, particularly during the dry season. However, during the monsoon at least one-third of the people drink haor water because they no longer have access to tube-wells which are located in portions of the *hati* which are cut off during the monsoon floods. As well, about one-fifth of the tube-wells remain out of order for most of the monsoon season.

Attendance in the schools during the monsoon months is poor mainly because of the transportation problem.

Table 2.1: Population of Shanir Haor

Thana	Union	Household within Shanir Haor	Population		
			Male	Female	Total
Bishwamvarpur	Fatehpur	1,116	4,121	3,727	7,848
Tahirpur	S. Sripur	512	1,705	1,534	3,239
	Tahirpur	946	2,913	2,754	5,667
	Balijuri	579	1,687	1,647	3,334
Jamalganj	Beheli	698	2,342	2,244	4,586
Total		3,859	12,768	11,906	24,674

Source: Bangladesh Bureau of Statistics

2.5 Agriculture and livestock

Land Use

The area available for cultivation in Shanir Haor is about 6,700 ha. The lowlands which occupy more than 92% of the area can only support a single crop which is planted after the water is drained out in the post-monsoon season. Local varieties of *boro* rice are the main crop grown on the lowlands. HYV *boro* is grown on some floodplain ridges and the upper part along the basin boundary. During the monsoon season some deepwater *aman* is grown along the project periphery. On the east side of the project, on high ridges adjoining rivers, transplanted *aman* is grown in the monsoon season followed by canola, mustard, coriander, sesame, chili or vegetable cultivation in areas which can be drained early. Sweet potato is grown in small areas on the highest land near rivers. The cropping intensity is very low, around 95%, because monsoon flooding restricts agriculture production to a single season and even then many potential fields can not be drained fast enough to allow for timely transplanting of *boro* rice.

Crop Cultivation Practices

Deepwater *aman* is sown in the pre-monsoon and harvested in the post-monsoon. The crop is grown mainly in the northeastern part, occupying only about 2% of the total cropped area in the project. According to the farmers, the area under deepwater *aman* has been decreasing in recent years due to an increase in flood depth. Deepwater *aman* is considered to be a high risk crop. Usually, farmers sow the broadcast field repeatedly trying to establish the crop. If the seedlings are destroyed by flood the fields are transplanted. The farmers raise sufficient seedlings so that they can transplant a second or third time before July when flood depth exceeds the submergence tolerance limit of the seedlings.

The capacity to elongate is one of the more important features of the deepwater *aman* rice plant. There are many deepwater *aman* varieties grown in Shanir Haor. The average yield in 1992 was estimated to be about 1.5 t/ha.

Transplanted *aman* is grown in the eastern part of the project covering about 1.5% of the total cropped area. The rice is mainly of the local varieties, and sometimes a local improved variety called *pajam*. After the harvest of transplanted *aman*, the land is often used for canola, and mustard.

Boro is the main crop in the project area covering more than 93% of the total cropped area. The *boro* rice includes both local varieties and HYVs, though more than 95% of the boro area is occupied by the local varieties. The local varieties mature earlier than HYVs. Early maturing is preferred to save the crop from pre-monsoon flooding. Local varieties can be classified into two groups, according to their growth duration and the land where they are grown. The two groups are *jagli* and *shail*. *Jagli boro* varieties are early maturing and are therefore well adapted to the land where flooding occurs earlier. The yield of the *shail* is higher but the longer growth duration makes them more prone to flooding. The quality of the *shail* varieties is better, and they sell at a little higher price than the *jagli* varieties.

Farmers generally prepare the seedbed by the first week of November and have the seeds sown by mid-November. Seedbeds are watered by traditional means. Some farmers, who have more land suitable for seedbeds, produce more seedlings than they require.

Land is ploughed by draught animals. But the demand for draught animals is high when the fields are being prepared. Few farmers own sufficient draught animals. Therefore, many of them choose to transplant without any tillage. Some HYV growers hire power tillers.

Transplanting starts from mid December and may continue until late January.

Fertilizers are applied only for HYV cultivation. Fields are weeded 2-3 weeks after transplanting. Irrigation water is mostly required from February to mid-April. Fields are usually irrigated by traditional means. One labour can irrigate 60 to 75 decimals of land per day by *don*. LLPs are used in some areas, mainly by HYV growers. Fuel prices are usually higher when it is time to irrigate due to high demand and transportation problems in the dry season.

Rice is harvested by local and migrant labours. Their pay is one-sixth to one-tenth of the harvested rice. Land type and rice variety are the criteria considered in deciding the proportion. Usually they take a larger proportion for harvesting the *jagli* variety.

Wheat is grown on the high ridges. Wheat occupies less than 1% of the total cropped area. The average yield was reported to be 1.6 t/ha. Mustard is grown in about 1% of the total cropped area. The popular variety is *sampad*, which is an improved variety. The yield is reported to be 0.55 t/ha. Other crops occupy about 1.5% of the total cropped area. They include: jute, potato, sweet potato, groundnut, radish, cabbage, eggplant, tomato, chili, and onion. Ploughing of land on the high ridges for *rabi* crops is difficult and expensive in the winter due to the high demand for draft animals.

Use of Fertilizers

Fertilizers are used mainly for HYV *boro* rice cultivation. Small amounts are also used in wheat, spices and vegetable cultivation. Fertilizers are available in the local market. An increase in the price during the *boro* season is common.

Green Manuring

The only source of green manuring is from the aquatic grasses, which grow naturally during the monsoon season. These are collected during land preparation and piled on the borders of the fields. Farmyard manure is rarely applied, and rice straw is used as feed, thatching and cooking fuel.

Livestock

The peak demand for draught animals is when the *boro* rice is transplanted. At this time there are not enough animals available and the price for one pair of bullock goes up to 10,000-12,000 taka; one pair of buffalo costs 20,000 to 25,000 taka.

Some farmers hire draught animals in exchange for 400 to 600 kg paddy per month. Fodder is provided by the farmers who hire the animals. However, this practice is not so common anymore because the owners fear that due to the general shortage of animals their animals will be over worked. The seasonal migrant workers (the *jeerati*) usually bring cattle with them.

Cattle are the main source of draught power. The management of draught animals is difficult due to shortage of feed and fodder. The main source of feed is rice straw. During the dry season this is complemented by grazing. The animals receive very little concentrated feed, only a small quantity of salt and a handful of rice bran/polishing which is produced in the households. Some

farmers use water hyacinth as cattle feed. Under-feeding and overworking weakens the draught animals during the land preparation period. When crops are damaged by floods the farmers need to go a great distant for straw.

Many farm families have only a few ducks. The farmers fear that more investment in ducks is too risky because diseases can quickly destroy the whole flock.

Farm Machinery Availability

Two tillers are available in Tahirpur *thana*: one is from the *thana* council and one is under the *thana* agriculture rehabilitation programme. Rent is about 400 taka/ha with 500 taka down as security money. Farmers also need to provide the driver's fee and fuel cost. In Biswamvarpur *thana* two power tillers are available at the *thana* agriculture office under the agriculture rehabilitation and KSS (Farmers' Co-operative Society) programmes. In this *thana*, however, there are seven or eight tillers owned by the farmers.

Marketing

Rice (mostly unhusked) is sold from the farmers' house to *beparis* (millers, agents of millers, or wholesalers) or at the local market. The *beparis* come to the Haor Area during the harvest season with large boats. Due to poor transportation and communication problems, the major share of rice produced in the project area is sold through this marketing channel. There are also itinerant traders who buy rice in exchange for other products.

In general, farmers retain enough rice for family consumption until the next harvest and sell any surplus. Some rice is also preserved as seed.

2.6 Fisheries

There are 32 *beels* located within the project area. The total *beel* area is about 517 ha. Eighteen *beels* of varying size (1.4-280 ha) located in the southwestern portion of the haor are known as the Bogiani Group Fishery. These *beels* cover a total area of 440 ha and are the deepest in the surrounding haor area. Most of the other *beels* in the project area are naturally connected with the Bogiani depression which in-turn is connected to the Nandia River through the regulator. Dhawa *beel* in the southeast area is the second largest fishery, covering 23 ha.

The majority of the fishing in the area is carried out at a subsistence level. Most poor people fish during the monsoon season. Those people living in the centre of the haor, or adjacent to the *beels* depend on fishing for their survival during a major part of the year. *Beel* fishing takes place during the dry season. *Beels* are managed by a lessee who gets a lease from the government for a specified period.

There are 12 villages in Shanir Haor where genuine fishermen live. About 164 groups with 334 fishermen live in these villages. There are 237 groups with 352 non-traditional fishermen recorded in 11 other villages who regularly fish in the haor.

There are five permanent fish markets located in the project area. In addition, about 20 temporary floating fishing markets are organized in different locations by the *nikaries* during the peak fishing season.

2.7 Forestry and Wetland Resources

Petrified tree stumps dug up by the local villagers in the northeastern corner of Shanir Haor are evidence of the occurrence of freshwater swamp forests in the past. Most tree stumps are *biyash* (Salix tetrasperma), and these can also be seen in homesteads within and around the project area (but are now few in number).

Almost all the homesteads within the project area have some sort of vegetation but insufficient cover makes them prone to erosion by wave action. Previously, water-tolerant tree species [*hizal* (Barringtonia acutangula), *koroch* (Pongamia pinnata), *borun* (Crataeva nurvula), *panidumur* (Trewia nudiflora), *biyash* (Salix tetrasperma)] were more abundant. Presently most of this tree cover is gone and only a few scattered trees can be seen around homesteads. Exceptions are the villages of Marala and Gopalpur where local people have planted some *koroch* trees on the village periphery. Marala is located in the southwest corner of the project area and during the monsoon water gushes out of the project area through either breaches or washed away embankments near this village. There is a small patch of locally protected swamp forest outside the project area, on the opposite bank near Nischintapur village.

In Tahirpur *thana* there are two nurseries. Seedlings of different fruits and trees are sufficiently available. The number of farmers receiving seedlings from the nurseries are increasing. In Biswamvarpur, seedlings of *mehagani* and other trees are available. Every year farmers plant mango, jackfruit, coconut and banana seedlings on their homestead land. *Mera, hizal* and *koroch* are also planted by the farmers. Branches of *koroch, hizal, borun* and other trees are used for *katha* fishing. The demand for branches cannot be met locally, so branches are brought from distant plantations.

Flood depths in the northeastern part of Shanir Haor are more shallow than other parts of the Haor. Sedimentation due to erosion of the submersible embankments and silt coming from the Jadukata River during monsoon, and sometimes intentional breaching activities, have raised the elevation of the haor in the east, southeast and northeast. During monsoon and also during the dry season, these shallow sections of the project area support emergent hydrophytes. There are changes in the occurrence of various species, and abundance. The northeastern section supports profuse growth of *parua* (Echinochloa colonum), which is dominant throughout the monsoon and sometimes causes navigational problems. Appendix G lists the plant species occurring within the project area.

Some grasses (such as *parua, erali*) are used for fodder and thatching, as well as mixed with cow-dung for fuel. *Parua* is sometimes considered a nuisance since profuse growth hinders local navigation within the haor. *Chailla* grass is in great demand by the local poor people. After harvesting the *boro* crop, the cultivable and fallow land support profuse growth of this grass. The grasses are collected by the local people and used as a barrier around their homesteads to protect against erosion from wave action during the monsoon floods. This grass has the ability to withstand rotting even after more than three months underwater. The fruit of the *singra* plant is collected for consumption by local people mostly during times of hardships when regular food sources are scarce; it is often traded in local markets as well. Several plant species have medicinal properties and are locally in demand.

Lack of cover and intensive human intervention on the wetlands has resulted in an impoverished fauna. Some species of frogs are heavily exploited, including *sona bang* (Rana tigrina) for the

commercial export trade (young ones for bait), and *kotkoti bang* (Rana cyanophlyctis) mostly for use as bait to catch large carnivorous fishes like boal. The Common Toad, *kuno bang* (Bufo melanostictus), act to control insect pests harmful to paddy and are used as bait.

Intensive human activities and lack of cover have almost driven out many of the common, harmless snakes like the rat snake (Ptyas mucosus). This species is also known as the farmer's friend as it eats on average three rats per day. Rodents have a tremendously high population within this project area. During the monsoon rodents take refuge in the higher grounds particularly in and around the homesteads. During the dry season they are reported to destroy crops. The freshwater turtles *jat kasim* (Aspideretes hurum), *sundi kasim* (Lissemys punctata), and *kali kaitta* (Hardella thurjii) are trapped for local consumption and are also exported to city markets.

The most conspicuous fauna elements are birds. The resident birds have suffered most because of human induced changes in the wetland habitat. Some groups such as the small bush birds have gone, while some seed-eating birds (eg. munias) have increased and sometimes become pests on the ripe paddy. Egrets, herons and other large wetland-dependent birds have either declined or moved away. During winter the haor supports over 5,000 migratory and resident ducks and other resident waterfowl, while during the monsoon the waterfowl population is below 100 individuals confined to resident species. Some rich people living around the haor hunt ducks. Some locals are also involved in trapping ducks for commercial purposes.

Among mammals only otters are commercially trapped for their fur coat. These animals take refuge in areas outside the project area and seldom come to the wetlands within the project. Dolphins are sometimes seen in the rivers around Shanir Haor, and sometimes get accidentally caught in fishing nets.

2.8 Navigation

With the total absence of roads and railways in the Shanir Haor area, the entire population is dependant in one way or another on navigation. During the monsoon season the whole Haor Area turns into a vast lake with only the village homesteads being high enough to remain as little islands. No one can move around the area without a boat. And with most of the area flooded to a depth of 5 m even the motorized country boats can have virtually direct access to any point. Starting from transportation of seedling, boats are used for almost all steps in the production and marketing of agricultural products. And the importance of boats in the fisheries is self explanatory. Boats which carry commercial cargo and passengers play a vital role in the economy of the area.

Most villages in the area have a large number (between 40 and 80 in the villages surveyed by NERP) of small country boats which are used for a number of domestic purposes as well as for transporting of goods and passengers. Some small boats carry passengers from one side of the haor to the other during the dry season. About 1,500 small boats can be seen at Sachna bazaar on market days during the monsoon; this gives an indication of the usefulness of country boats in the area. In addition, there are a number of mechanized country boats based in Shanir Haor which transport cargo and passengers on a commercial scale.

It is estimated that about 3,000-5,000 barki boats are engaged in the collection and transportation of sand on the Jadukata River north of Fazilpur, and about half of them are from the Shanir Haor area. About 90% of these boats are owner operated, few of whom own land.

Boats in Shanir Haor are engaged in the following types of activities:

- Transportation of agricultural inputs/produce to and from the fields.
- Fishing and transportation of fish.
- Transportation of sand, shingle and boulders to Fazilpur from the border area.
- Collection of boulder at Bholaganj.
- Collection of earth for homestead protection.
- Transporting different types of cargo.
- Transporting passengers.

While paddy, boulders, sand, shingles and fish are the main commodities transported out of the area, consumer goods, fertilizers and other agricultural inputs are the main imports into the Haor Area. All are transported by boat.

Shanir Haor is surrounded by rivers and by half a dozen other haors. Thus it is cut off from the rest of the country by all other transportation means except by waterways. However this vital link can not be maintained year-round. During the dry season travel through the haors is impossible for anything but the smallest craft which must move along the small drainage canals. So most boat traffic must follow the rivers which increases the travel time considerably. But even in the rivers there are many sections which are badly silted and prevent boats from passing. The worst sections are in the lower Rakti (after the Nandia take-off) and in the upper Baulai (where it splits from the Jadukata). Parts of these sections are said to be completely dry during the winter months.

3. PROJECT MONITORING FIELDWORK

3.1 Hydrology

Hydrological monitoring began on 15 May 1992 and was terminated on 27 May 1994. Water level was measured with staff gauges at the following locations:

i) the Baulai River water level at Marala,
ii) the Shanir Haor water level at Marala,
iii) the Baulai River water level at Tahirpur,
iv) the Shanir Haor water level at Tahirpur.

Daily rainfall was recorded at Marala. Pan evaporation was measured at Sunamganj.

3.2 River Morphology and Sedimentology

Morphologic surveys were carried out to monitor ongoing channel changes in the rivers adjacent to the project area. The main purpose of these measurements was to monitor aggradation/ degradation in the channel. Preliminary surveys were also made inside the haor to measure the haor floor level changes since the last topographic survey of 1963. Table 3.1 lists the dates of surveys, sites visited and the nature of the work that was carried out.

The repeat cross section surveys were made by establishing permanent masonry hubs on each bank of the river and then surveying the channel with a portable echo-sounder and tag line. Locations of all hubs were established by Global Positioning System (GPS) measurements. GPS and the echo-sounder were also used to carry out section line surveys through the haor. Results of the survey are included in appendix B.

Table 3.1: Survey Program at Shanir Haor of Sedimentology Team

Date	Work Carried Out
Jun 18 - Jun 29, 1992	River cross sections surveys
Nov 22 - Nov 27, 1992	River cross sections & long sections surveys, bed material samples
Jan 23 - Jan 27, 1993	Bore hole sediment samples
Feb 02 - Feb 07, 1993	Elevation surveys
Jun 28 - Jul 01, 1993	River cross sections & haor sections surveys
Oct 04 - Oct 06, 1993	Haor section surveys

Table 3.2: Social Anthropology Data Collection in Shanir Haor

Year	Month	Days	No. of field staff
1992	February	26-29	5
	March	1-31	5
	April	1-30	5
	May	1-15	5
	June	1-30	2
	July	1-31	2
	August	1-31	2
	September	1-31	2
	October	1-31	2
	November	1-30	2
	December	1-31	2
1993	January	1-31	2
	February	1-28	2
	March	1-31	2
	April	1-30	2
	May	1-31	2
	June	1-30	2
	July	1-31	2
	August	1-31	2
	September	1-30	2
	October	1-31	2
	November	1-30	2
	December	1-31	2
1994	January	1-31	2
	February	1-28	2
	March	1-8	4
		20-31	4
	April	1-30	3
	May	1-15	3

3.3 Sociology

Social-anthropological data were collected by a field team stationed at Beheli. Field work was carried out in two phases. During the first phase from February to May 1992 the team was involved in collecting baseline information. A sample survey was undertaken in the villages of Beheli Union; two villages were predominantly agricultural villages (Shibpur, Chandipur) and one was predominantly a fishing village (Alipur).

In the second phase, from June 1992 onwards, selected issues and processes pertaining to people's life and livelihood in the haor were regularly observed and monitored. Six villages were selected for this purpose: Sahaganj and Marala in Sripur Union, Amirpur in Balijuri Union, Islampur in Beheli Union and Birnagar in Tahirpur Union.

3.4 Agriculture and livestock

The Agricultural Specialist made regular visits to the field. Some of the agricultural data was collected during these visits while much of the data was collected through the NERP sociology field team at the direction of the Agricultural Specialist.

3.5 Fisheries

Fisheries fieldwork started in May 1992. Dates of the field visits are given in Table 3.3. Field work included catch assessment surveys, a frame survey, and sampling of fish stocks.

3.6 Forestry and Wetland Resources

The environment team conducted the following investigations:

- survey of the floral composition of the wetland, homesteads, and fallow land.
- survey of the fauna (amphibia to mammals) in wetland, and homesteads.
- utilization of flora/floral products, fauna/faunal products by the local people.
- public attitude towards preservation and utilization of renewable biological resources.

The Environment Specialist made regular visits to the field. Some of the environmental data was collected during these visits while much of the data was collected through the NERP sociology field team at the direction of the Environment Specialist.

3.7 Navigation

The Social Anthropology team monitored seasonal variations of several factors important to navigation, including water level, route condition, boat operation, and types of cargo. In addition, the navigation study team visited Shanir Haor on a number of occasions to collect more specific data on the navigation conditions and on the activities of country boats during the various seasons of the year. The team also monitored important issues such as the number of people employed in the country boat sector and public cuts made for navigation purposes.

Table 3.3: Fisheries Data Collection in Shanir Haor

Period of Field Trip	Season	Hydrological Condition inside Haor
14-15 May 92	Early monsoon	Partially flooded
15-25 June 92		Fully flooded
13-18 July 92		Fully flooded
06-23 Aug 92	Mid monsoon	Fully flooded
10-25 Sep 92		Fully flooded
23Oct-12Nov 92	Late monsoon	Flooded receding
12-23 Dec 92	Dry season	Flood receding but land is not completely dry
12-15 Jan 93		Partially flooded by the flash-flood
18-26 Feb 93		Partially flooded by the flash-flood
02-09 March 93		Water in the beel
05-14 April 93		Water in the beel
24-30 April 93		Water in the beel
11-17 May 93	Early monsoon	Fully flooded
11-26 June 93		Fully flooded
15-28 July 93		Fully flooded
13-22 Aug 93	Mid monsoon	Fully flooded
13-20 Sep 93		Fully flooded
18-30 Oct 93	Late monsoon	Fully flooded
17-27 Nov 93		Water receding
13-23 Dec 93	Dry season	Water receding rapidly
16-28 Jan 94		Water in the beel
15-21 Feb 94		Water in the beel
23-30 March 94		Rain water increases the water level
22-26 April 94		Rain water increases the water level
07-09 May 94	Early monsoon	Rain water increases the water level

4. CHRONOLOGY OF EVENTS AND PROJECT IMPACTS (1992-94)

4.1 Project Hydrology

The hydraulic performance of Shanir Haor Project is one of the most important factors affecting social activity, agriculture, fisheries and navigation within the haor. During 1992-94 this performance has been influenced by:

a) rainfall, evaporation and infiltration at the haor surface.
b) floods in the surrounding river system.
c) operation of the Bogiani Regulator.
d) public cutting and (natural) breaching of the embankment.

These influences were monitored quantitatively as:

i) the Baulai River water level at Marala, MR (m PWD)
ii) the Shanir Haor water level at Marala, MH (m PWD)
iii) the daily rainfall at Marala (mm)

Inspection of the water level hydrographs (on the following page) reveals three *natural* phases in the hydraulic performance of the haor:

1) Flushing Phase: MR > MH: In this phase the river water level always exceeds the haor water level and so a positive hydraulic head exists across the river banks [that is (MR-MH) > 0]. This head causes water to flow from the surrounding river system, over the river banks, and into the haor. This process is called *flushing*, and usually takes place during the pre-monsoon.

2) Inundation Phase: MR = MH: In this phase the river and haor water levels are always coincident, and so no hydraulic head exists across the river bank [that is (MR-MH)=0]. This implies that there is no flow across the river bank. However, the water levels continue to rise and fall in this phase, and flow must therefore be occurring in and out of the haor. The driving head for this flow must be that existing across the whole region in which Shanir Haor is located. This phase takes place during the monsoon.

3) Drainage Phase: MR < MH: In this phase the haor water level always exceeds the river water level, and so a negative hydraulic head exists across the river banks [that is (MR-MH) < 0]. This head causes water to flow from the haor, over the river banks, and into the surrounding river system. This process is called draining., and takes place mainly during the dry season.

When, as in the case of Shanir Haor, engineering works have been introduced, the natural flushing and draining phases are modified by the presence and operation of these works. The works serve to delay the onset of flushing, and to slow draining.

When engineering works are present, the natural flushing phase during the pre-monsoon is replaced by:

1a) Protection Phase: $d(MH)/dt \sim 0$: In this artificial phase, flow into the haor is prevented by the presence of the project embankment and closure of the regulator. As a result the haor water level does not rise over time, although it may fluctuate slightly due to rainfall, evaporation and infiltration [that is $d(MH)/dt \sim 0$], a fact which is instantly recognisable on the haor water level hydrograph. Basically, in this artificial phase, the *boro* crop is being protected from pre-monsoon flooding, and so it may be called the *protection* phase. Since the haor water level is prevented from rising in this phase, the hydraulic head (MR-MH) is larger at the end of this phase than it would be at the end of a natural flushing phase [that is $(MR\text{-}MH)_A > (MR\text{-}MH)_N$] where the subscripts A and N indicate artificial and natural conditions.

1b) Accelerated Flushing Phase: $[d(MH)/dt]_A > [d(MH)/dt]_N >> 0$: When the regulator is opened flushing of the haor occurs much more rapidly than it would in a natural flushing phase because of the higher hydraulic head developed in the preceding protection phase. The haor water level then rises very rapidly, and more rapidly than in a natural flushing phase; this can be expressed as:

$$[d(MH)/dt]_A > [d(MH)/dt]_N >> 0$$

the latter inequality being instantly recognisable on the haor water level hydrograph. This artificial phase may be called the *accelerated flushing phase*.

Also when engineering works are present the later part of the natural draining phase during the dry season is replaced by:

3a) Decelerated Drainage Phase: $[d(MH)/dt]_A < [d(MH)/dt]_N$: This artificial phase begins when the regulator is closed to retain water for irrigation. In this case there is a reduction in the drainage flow, and this is reflected in a change in the rate of fall of the haor water level. This can be expressed as:

$$[d(MH)/dt]_A < [d(MH)/dt]_N$$

but it may, or may not, be readily recognisable on the haor water level hydrograph. This artificial phase may be called the *decelerated drainage phase*.

Having established the possible phases in hydraulic operation of the haor it is possible to identify key dates and times in the year corresponding to the ending of one phase and the beginning of the next. Water levels, and the actions taken by the regulator operator, or others, which caused the phase change on these key dates are of considerable interest.

Since the PMP fieldwork did not begin until 15 May 1992 nothing is known of the hydraulic performance prior to that date.

Table 4.1: Summary of Climatic Seasons and Hydrological Phases at Shanir Haor

Chronological Year	Climatic Season	Hydrology	
		Phase	Starting Date
Year 1: May 1992 - April 1993	Pre-monsoon	Accelerated Flushing	16 May 1992
	Monsoon	Inundation	14 June 1992
	Dry Season	Decelerated Drainage	27 Oct 1992
	Pre-monsoon	Protection	17 Feb 1993
Year 2: May 1993 - May 1994	"	Accelerated Flushing	10 May 1993
	Monsoon	Inundation	16 May 1993
	Dry Season	Decelerated Drainage	20 Oct 1993
	Pre-monsoon	Protection	11 March 1994
	"	Accelerated Flushing	16 May 1994

YEAR 1: May 1992 - April 1993

15 May 1992: Water level gauges were established at Marala on this day when it was observed that:

a) the Baulai River water level was 2.1 m below the crest of the project embankment at Marala; this water level corresponds to elevation 3.84 m PWD.

b) the Shanir Haor water level was below the bottom of the lowest haor side staff gauge (H2) installed at Marala. No water was to be seen on the haor lands except for a few isolated pools near Ahmokkhali Khal. There was apparently stagnant water in Ahmokkhali Khal.

After completing installation of the gauges at Marala, the Bogiani Regulator was visited and it was observed that:

c) fallboard barricades in the regulator were installed to full height, their crest being a few centimetres below the deck soffit and several metres above both the riverside and haor side water levels at the regulator.

d) on the haor side of the regulator there was apparently stagnant water in Bogiani Khal which filled its channel to less than half its depth; it has been estimated that the haor water level was 1.83 m PWD.

During this visit to the regulator the operator (*kalashi*) was spoken to, and he indicated that he intended to remove the fallboards on 16 May as per his standing instruction from BWDB. He

also mentioned that it is not possible for him to remove fallboards when they are submerged on one side and the river and haor water levels differ by more than a metre, and that the bottom several fallboards are virtually immovable under any flow condition.

Accelerated Flushing Phase: 16 May 1992-14 June 1992

16-18 May 1992: Although it cannot be definitely confirmed it seems very probable that the operator did remove fallboards in this period. It is known that on 16 May fishermen cut the project embankment at Marala and at least one other location. It is therefore assumed that all three locations would have contributed to flushing of the haor.

18 May 1992: Regular water level observations began at Marala on this day when it was recorded that:

a) the Baulai River water level had risen to 4.73 m PWD, or by 0.89 m since the isolated observation on 15 May.

b) the water level in Shanir Haor (now recordable on H2) had risen to 2.75 m PWD, or by 0.92 m since the isolated estimate of the haor water level on 15 May.

18 May 1992 - 14 June 1992: The haor continued to fill with water during this period. Rainfall data are not available for May 1992, but it is known that rainfall occurred. The river water levels show there were two small floods in the Baulai River in this period. Haor filling resulted, however, mainly from the large differences in water level across the regulator and the public cuts.

Inundation Phase: 14 June 1992 - 27 October 1992

14 June 1992: The river and haor water levels equalised at 5.95 m PWD (the crest level of the embankment there) during the night of 13/14 June 1992, and by 07:00 on 14 June 1992 the water levels at Marala were both 6.25 m PWD, or 0.30 m above the crest of the embankment.

14 June 1992 at 24:00	MR = 5.95 m PWD MH = 5.95 m PWD

14 June 1992 - 4 July 1992: Throughout this period the river and haor levels coincided, and rose in response to three significant floods in the river. The second highest water level of 1992-93 occurred on:

28 June at 07:00	MR = 7.09 m PWD MH = 7.09 m PWD

The annual maximum river/haor water level of 1992-93 occurred on:

4 July 1992 at 17:00	MR = 7.37 m PWD MH = 7.37 m PWD

and third highest water level of the year on:

30 September 1992 at 07:00 MR = 7.08 m PWD
MH = 7.08 m PWD

DRY SEASON

Decelerated Drainage Phase: 27 October 1992 - 17 February 1993

27 October 1992: The declining coincident river and haor water levels reached the crest of the project embankment at Marala on:

27 October 1992 at 12:00 MR = 5.95 m PWD
MH = 5.95 m PWD

Thereafter the river and haor water levels began to diverge, the river water level being 0.03 m below the haor water level by 17:00.

27 October 1992 - 17 February 1993: Throughout this period the river and haor water levels continued to diverge slowly. This period is classified as one of decelerated drainage because, it is believed, 12 fallboards remained in the barricades of the Bogiani Regulator throughout the period 15 May 1992 - 15 May 1994; these are the fallboards the operator cannot remove under any flow condition. The rate of haor water level decline does appear to decrease in late December 1992 when more fallboards may have been added to the barricades, but this has not been confirmed. Water level in the haor began increasing on 7 January. The haor level rose by 24 cm, while the river level rose by 86 cm.

Protection Phase: 17 February 1993 - 10 May 1993

17 February 1993: On the night of 17/18 February a significant hydrological event took place in Shanir Haor. A nor'wester arrived in the afternoon of 17 February 1993, and heavy rain fell on the southern slopes of the Shillong Plateau. Although rainfall at Shanir Haor was relatively light. The large flood which followed this night's storm was a relatively improbable event for this time of year.

Minimum water levels just prior to the onset of this flood were:

17 February 1993 at 17:00 MR = 2.45 m PWD
MH = 2.48 m PWD

17 February 1993 - 10 May 1993: The flood which began to rise on 17 February 1993 peaked one week later on:

24 February 1993 at 24:00 MR = 4.86 m PWD
MH = 2.65 m PWD

A rise of 2.21 m (4.86 - 2.65) in the haor water level was averted.

Similar nor'westers followed later in March and April giving rise to further flash-floods:

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29 March 1993 at 17:00 MR = 4.43 m PWD
MH = 2.66 m PWD

13 April 1993 at 24:00 MR = 3.58 m PWD
MH = 2.73 m PWD

Throughout this period the haor water level remained virtually constant; the slight rise (0.07 m) which did occur is attributed to rainfall on the haor and leakage through the Bogiani Regulator and elsewhere.

The minimum water levels at the end of this period were:

24 April 1993 at 17:00 MR = 3.09 m PWD
MH = 2.72 m PWD

Further nor'westers occurred in late April and early May 1993 giving rise to a rapid merging succession of flash-floods in the surrounding rivers. The haor water level crept up from 2.72 m PWD to 3.60 m PWD between 24 April 1993 and 10 May 1993, apparently due to water entering the haor through unclosed cuts or breaches.

YEAR 2: May 1993 - May 1994

Accelerated Flushing Phase : 10 - 16 May 1993

When the fallboards were removed, apparently on 10 May 1993 (6 days ahead of schedule), the haor water level rose very rapidly reaching the crest level of the embankment at Marala on:

16 May 1993 MR = 5.95 m PWD
MH = 5.95 m PWD

Why the fallboards were removed prematurely is not definitely known, but it seems probable that the operator, seeing the water levels rising early, decided to get them out while he was still able to. Some crop losses resulted.

MONSOON

Inundation Phase : 16 May 1993 - 20 October 1993

16 May 1993: The river and haor water levels reached the crest of the project embankment at Marala on:

16 May 1993 at 00:00 MR = 5.95 m PWD
MH = 5.95 m PWD

The water was rising rapidly reaching 6.10 m PWD by 17:00.

17 May 1993 - 20 October 1993: The river and haor water levels continued to coincide throughout this period during which a considerably larger volume of water was present in the haor than in the corresponding period of the previous year. The peak water level was reached on:

22 July 1993 at 07:00	MR : 8.10 m PWD MH : 8.10 m PWD

DRY SEASON

Decelerated Drainage Phase: 20 October 1993 - 12 March 1994

20 October 1993: The declining coincident river and haor water levels reached the crest of the project embankment at Marala on:

20 October 1993 at 17:00	MR = 5.95 m PWD MH = 5.95 m PWD

Thereafter the river and haor water levels began to diverge, the river water level being 0.04 m below the haor water level by 07:00 on 21 October 1993.

20 October 1993 - 31 January 1994: Throughout this period the river and haor water levels continued to diverge slowly. This period is classified as one of decelerated drainage because, it is believed, 12 fallboards remained in the barricades of the Bogiani Regulator throughout the period 15 May 1992 - 15 May 1994; these are the fallboards the operator cannot remove under any flow condition. The rate of haor water level decline does appear to decrease in late December 1993 when more fallboards may have been added to the barricades, but this has not been confirmed. The minimum water level was reached on:

31 January 1994 at 17:00	MR = 2.37 m PWD MH = 2.42 m PWD

31 January 1994 - 12 March 1994: The haor water level remained essentially steady until 12 March 1994, apparently as a result of the lower fallboards being in place and serving to retain water for irrigation. The river water level in this period continued to decline reaching a minimum on:

12 March at 17:00	MR = 1.76 m PWD MH = 2.42 m PWD

PRE-MONSOON

Protection Phase: 11 March 1994 - 16 May 1994

12 March 1994: The river water level began to rise again on the night of 12/13 March 1994.

13 March 1994 - 16 May 1994: The rise in river water level continued and accelerated until a peak was reached on:

7 April 1994 at 17:00	MR = 5.68 m PWD MH = 2.91 m PWD

The rise of 0.49 m in the haor water level which occurred in response to this flood appears due to leakage into the haor through a cut or breach.

Accelerated Flushing Phase: 16 May 1994 - 27 May 1994

The fallboards were clearly removed on 16 May 1994 as indicated by the following change in water levels:

16 May 1994 at 07:00	MR : 5.12 m PWD MH : 3.10 m PWD
27 May 1994 at 07:00	MR : 5.26 m PWD MH : 5.28 m PWD

Shanir Haor PMP observations of water levels were discontinued on 27 May 1994 just prior to equalization of the river and haor water levels.

4.2 Field Observations

YEAR 1: May 1992 - April 1993

PRE-MONSOON

There was rain on 16 and 17 May which produced a flash-flood. The flood allowed most of the fishermen in the area to engage in "uzaia fishing" for two or three days. This involved cutting the embankments to trap broodstock which were trying to enter the haor to breed. On the night of 17 to 18 May the embankment just east of Beheli was cut by the *jalmohal* lessee also to trap broodstock. As a result about 1,800 *ker* of rice, with an expected production of 2 *maund* per *ker*, was damaged. The Beldubi embankment was also cut on the same night by another group also for fishing, which caused extensive damage to the crop in this area as well. After the water levels stabilised the fishing intensity declined. About two weeks later fishermen began using *kona* nets (2 mm mesh) to harvest fish fry. It was estimated that during the month of June more than one metric ton of fry per day was caught in the Shanir Haor area. This type of fishing is illegal.

During this season local people were collecting *chailla* and *parua* grasses. Some children were observed collecting *singra* and *kai*. Several people came to the haor to trap otters. Rodents were observed in the higher, fallow land as well as in the marginal cultivable land. Fifty rodents were observed during a ten minute walk which gives an indication of the presence of a high rodent population.

In an interview with a *patam* boat operator who had been collecting sand from Fazilpur for the last 30 years, he stated that the only draught problem on the Nandia River is at Beheli. He said that it would be better for boatmen if the Rakti River could remain open the whole year since this was the most direct route to the Surma River from Fazilpur. On a single day in the pre-monsoon season the following boats were seen at Beheli:

ORIGIN	No.of boats	CAPACITY (maunds)
Nakalia	7	900 - 1000
Bera	2	900 - 1000
Mirjapur	4	500 - 600
Kustia	4	800 - 900
Jhitka	1	550

All these boats were in Beheli to purchase paddy which would be transported as far as Dhaka. Each of these boats made several trips that year and together with other boats they carried about 80,000 *maunds* of paddy from Shanir Haor.

MONSOON

The people of the haor indicated that the water level inside the haor had risen at a slower rate than in the previous year. They had more time to construct the *baribandha* - a barrier which protects the homesteads from wave action during the floods. The cost of *baribandha* depends mainly on the price of bamboo. This year 100 pieces of bamboo cost about 2,200 taka. Each bamboo is 10-12 m long and can be cut into three pieces. About 85-90 bundles of *chailla* are needed for one linear meter of *baribandha*. One labourer can collect 200-250 bundles of *chailla* in a day.

By July the fish *aarats* (markets) were in full operation at Tahirpur, Shahganj and Islampur. In other parts of the haor, *nikaries* (fish retailers) were moving from village to village buying fish. The amount of agricultural employment had declined drastically and many people were engaged in open water fishing.

By mid-monsoon more and more people were fishing in the haor resulting in a serious decline in catch size. The decreasing catches resulted in the use of a wide range of fishing gear (some of which were illegal). Those who were unable to invest money for fishing gear left in search of work elsewhere. Some traditional fishermen were also not able to purchase proper gear. Other, wealthier individuals were able to invest large sums in fishing gear.

The water level in the haor began receding in September and the area of water available to the public for fishing decreased. In addition the *beel* lease holders had hired guards *(paharadars)* to prevent people from fishing near the *beels*. Fishermen complained that these guards harass them in areas where they have no jurisdiction. One long-time fisherman related how he had to give a part of his catch (the largest fish) to a gang of *paharadars* who threatened him. Some small farmers who had recently entered into fishery activities had purchased current nets and were occasionally using them in shallow waters adjacent to their villages. Apparently, they also secretly fish in the *beels*. They note the surveillance schedule of the *paharadars* and then are careful not to be in the *beel* when they make their rounds. It is possible to set current nets on the bottom in deep water without markers (thus escaping the notice of *paharadars*) and to relocate them later by using visual triangulation.

Towards the end of the monsoon season people of the haor began collecting *singra* and *parua* from areas where water has receded. Snails were also collected in large numbers. Farmers use the meat from the snail for duck feed, and the shells are often ground up for lime. Some migratory birds (mostly Pintail, Garganey, Tufted Duck) had started arriving in the haor.

DRY SEASON

By late October most of the people (including fishermen) who were fishing during the whole monsoon season no longer had the opportunity to do so due to the strict control of the *paharadars*. A few fishermen near the villages of Islampur and Chandipur, were able to fish by paying *baksheesh* to *paharadars*. Some of the traditional fishermen tried to negotiate with the leaseholders to get subleases for parts of the river. Others purchased fish to dry and resell. Most people could only fish the shallow waters adjacent to their houses, but catches were low.

A great deal of activity was observed on the Jadukata and Rakti Rivers at the beginning of the dry season. Six thousand *Barki* boats were said to operate on the Jadukata bringing sand and gravel down from the border area. At Fazilpur the loads are transferred to larger cargo boats which take it down to the Surma River and then further south. Although this quarrying activity seems to go on throughout the year the end of the monsoon and beginning of the dry season seems to be the peak season because water levels are low enough to get the sediment but high enough for the big cargo vessels to come all the way to Fazilpur.

The poor people began collecting *khai* from the haor in the second week of November, and continued throughout the winter. The harvest of *khai* decreased later in the season as more land was brought under cultivation. It is possible to collect 1-2 kg of *khai* in a day. They also collect *durba* (grass) for fuel and wild *shak* as a vegetable.

Longitudinal profiles of the rivers around the haor were prepared in November. It was observed that generally the Rakti River had water depths of 3 to 4 meters; the Nandia Gang was deeper at about 6 meters; and the Baulai gradually decreases in depth moving upstream to less than one m in the last few kilometres before Fazilpur; the Jadukata River was shallow at only about two meters at the mouth of the river. (Average water elevation was about 3.7 m PWD on the days of the survey.) "Instability" in the river beds was observed on both the Baulai and Rakti downstream of their junction with the Jadukata - this suggests that their sediment was still being transported by these rivers at this time of the year.

A preliminary depth investigation inside the haor revealed that the depth of *khals* were about four meters but that the rest of the haor was flat with depths of only two or three meters. One interesting feature was a scour hole at the Ahmokkhali Khal, south of Marala, which dropped to more than 16 meters in depth. At this location the embankment is cut every year.

A form of illegal fishing called "gang fishing" was observed in Shanir Haor during the late monsoon. These gangs are organized groups of fishermen poaching en mass in a particular *beel* or haor using spears and guns. A leader of one gang (who was in jail for three years) gave the following reasons for "gang fishing":

- local fishermen/men are not getting *jalmohal* leases;
- Leaseholders do not allow the local people to carry out subsistence fishing during the monsoon;
- there are no job opportunities during the monsoon;

In Shanir Haor a "gang fishing" incident occurred on 12-14 November 1992 in the Shanirua Group Fishery which was carried out by the leaseholder of Chatol Group Fishery because of a conflict between the two leaseholders. About 35-40 hired fishermen used 15 boats to fish the

beels using mostly current and gill nets. The leaseholder of the Shanirua lost about 50,000 taka worth of fish to the gang. Both of the conflicting parties filed a criminal case against each other with the Jamalganj police office.

It was reported that farmers were pulling-up tree stumps "by the thousands" ever year, when they were preparing their fields. The problem is said to be particularly acute in the northeastern portion of the haor.

In December there was an increase in the number (about 1,200) and species of migratory waterfowl observed in the haor. Several hunters were seen, and two gunshots heard during a field visit. Also, three persons were seen using nets to trap birds.

The amount of money that was being borrowed during this dry season appeared to be less than in the previous year. The general economic situation had improved from 1992 because of an increase in wage rates and a decrease in the price of rice.

By January the *boro* rice had been transplanted. On 7 January the water level in the river began to rise. It increased by 86 cm. Water entered Shanir Haor through several breaches and the water level inside the haor rose by 24 cm. Agricultural activities, which were temporarily halted, intensified as soon as the water was drained out. In highland areas most of the households had finished ploughing and transplanting. But farmers of low-lying areas could not complete land preparation or transplanting.

In January the soils engineering company contracted by SRP was on site in Shanir Haor to drill bore holes at 2 locations. One of the sites was at the Beheli Khal and the other was at the Ahmokkali Khal. At both sites three bore holes were drilled. All the holes were drilled to a depth of 20 meters. Standard penetration tests were conducted, and samples were collected every five feet. Five to six (depending on the number of soil layers) Shelby-tube samples were also taken from each hole. All samples where sent to Dhaka for analysis. Some soil samples from the bore holes were brought back immediately for testing, the Shelby-tube samples were inspected later in the lab and additional samples were taken. At the Ahmokkhali site organic material was found in the 9'6"-11'0" layer in all three holes. Samples were collected from this layer including a large piece of wood from a tree trunk/stump. No organic material was found at lower depths. At the Beheli site no organic material was found.

The *beel* leaseholders did not hire any local fishermen. Many fishermen from outside the area had assembled at Bogiani *khola* in January. However, beel fishing did not start until later in the month due to high water levels. The traditional fishermen of Shanir Haor tried to fish elsewhere (in the rivers and in other haors). The fishing by the seasonal fishermen and the general public has decreased as most were engaged in agricultural activities. Children continued to fish, particularly for *icha* and other small fish, with *thela* nets.

In January there was a sudden rise in the population of migratory ducks (about 15,000). Eggs of Pallas' Fish Eagle had hatched and eaglets were observed in a nest near Nischintapur. Grasses like *parua* and other wetland plants had started to decompose. They were used as green manure.

PRE-MONSOON

It was observed that in February the Baulai River take-off, at Fazilpur, was dried up. Most of the sediment being removed from the Jadukata area, at this time of the year, appeared to be shingles or small boulders (up to 20 cm in size). It is estimated that only about 25% (possibly less) of the boats were carrying sand. There were fewer *Barki* boats working on the Jadukata, though a proper estimate of their number was not possible. The price per boat load of sediment was about 100 taka; down from the November price of 125 to 150 taka. There does not seem to be a definite exchange point at this time of the year. Piles of sediment were noticed along the banks of the Rakti all the way from Fazilpur to the Nandia take-off. The transfer point seems to depend on the cargo boats that carry the sediment down to the Surma River. The smaller cargo boats are able to go further upstream; therefore the exchange is closer to Fazilpur. There were a number of poorer people gleaning sand from the river bed, and the banks near Fazilpur for the purpose of selling it to local traders.

The night of 17/18 February 1993 is one which local farmers are likely to long remember. A nor'wester arrived in the afternoon of 17 February 1993, and heavy rain fell on the southern slopes of the Shillong Plateau. Although rainfall at Shanir Haor was relatively light, the heavy rain in the distance was observed and it was realised that a substantial flash-flood was imminent. A large work force was mobilised to fill in the public cuts in the embankment and to help the operator install all remaining fallboards in the barricades of the Bogiani Regulator. As a result only a small amount of the *boro* crop in Shanir Haor was damaged. Other haors in Sunamganj District, where no similar defensive action was taken, were substantially flooded and much of their *boro* crop was lost. The river water levels rose by over two m in the following week. Agricultural activities decreased after these rains.

In March people of the haor were engaged in house construction and repair, as well as in post-harvest activities of oilseeds such as sesame. The consumption of fresh fish had decreased as the price increased. On the other hand consumption of dry fish increased. Many poor people began eating sweet potato instead of rice. Also, women and children were seen collecting *singra* from the haor which they also eat as a rice substitute; some people also sell *singra*.

Fishermen of Islampur and Nayanagar caught large quantities of fish during the month of March. *Chouhanda* fishermen could not catch much fish this year due to the high level of water in the haor.

In April, 22 groups of *bepari* (290 persons in total) were engaged in harvesting paddy from the beginning of the month of Baishakh. Among them, 10 groups were local and 12 groups were from outside the haor. The daily wage is 10 *seer* of rice for harvesting of local *boro* varieties and 20 *seer* for harvesting of HYV varieties. In Baishakh, they do not work for cash.

The harvest of local *boro* rice started in highland areas on 2 April. Harvest activities intensified after the third week of April. On 9-11 April Shanir Haor had rain but crops were not endangered. In April many villagers were catching broodstock which were passing through embankment cuts to breed in the haor.

YEAR 2: May 1993 - May 1994

PRE-MONSOON

It started raining on the first day of May. The floods which followed the heavy rains caused much crop damage. The embankment was breached at Kaijauri on 5 May, at Ramjivanpur on 9 May, and at Marala on 12 May. The haor was inundated on 13 May. The people had to harvest with whatever means they had and faced problems of transportation, drying and storage. During the harvest there was a shortage of labour. The number of labourers from outside the area was down from previous years. Some plot owners were hiring labourers at 200-300 taka per *ker*.

However, the rise in water levels was good for navigation. Large cargo vessels could again carry sand from Fazilpur through the Nandia River. But, a 200 *maund* capacity boat, loaded with sand, was still experiencing draught problems in the Rakti on 14 May even though it was not fully loaded. On 13 May, the captain of a large cargo vessel loaded with paddy was interviewed at Beheli. He said that normally his vessel carries sand from Durlavpur (where the Rakti joins the Surma) to Dhaka and gets a freight rate of 5 taka per cubic foot. But he was carrying paddy this time because of he was getting a higher freight rate (22 taka per maund).

Fishermen earned 50-120 taka per day in April, but in May fishermen of Islampur reportedly earned 200-300 taka per day. Some fishermen used *kona* nets to harvest fish fry and some used hooks and line to catch snakehead, or *pabda,* fish. Fish were abundant.

MONSOON

Due to the early floods in May, harvesting and post-harvest activities were carried out hurriedly and there was little time to make the annual repairs to their homesteads. As a result the platforms around many of the homesteads experienced a significant amount of erosion due to wave action during the monsoon floods. Marala was one of these villages; two of the hubs installed by the NERP sediment team at Marala were washed away. Some farmers shifted their cattle to other villages.

Fishermen of the area were pleased with the early inundation of the haor even though most of them were not able to repair their houses in time. Despite increased risks of working in heavy waves a large percentage of the traditional fishermen were observed fishing with hook and line in the open haor. Some non-traditional fishermen were observed fishing with current nets. The fishermen from Islampur stated that they had to pay for fishing permits; the rates ranged between 150 to 300 Taka/month/boat depending on the type of net used.

There was much sediment collection activity at Fazilpur. There were numerous large cargo boats receiving sand and stones. Stones 20 - 30 cm in size were being brought down from the border area; these were larger than what was observed the previous year. The *barki* boats were paid about 250 taka for a boat load of stones. It is estimated that about 25-30% of the boats were carrying stones of this size.

Many of the haor villages were effected by flood during the month of August. Severe fodder shortages were being faced by about 25% of households. It was reported that about 5% of households had sold their cattle. Fishing activity declined markedly due to implementation of the

Fish Conservation Act in observance of the Fish Fortnight from 1-15 August. Some current nets were seized by the Thana Fishery Officers of Tahirpur and Jamalganj thanas. The presence of the Bogiani Group Fishery's *paharaders* also restricts free fishing in the haor. Current nets and *larborshi* were the main fishing gear used during this period.

In September women began sowing vegetables in the homesteads. But, due to excessive rainfall there was an insect problem. *Aman* was transplanted in some of the highland areas. About 15% of the farmers used the *pazam* variety and 85% used traditional varieties (mainly *birui*). Few farmers prepared seedbeds for *t.aman*. Labourers started returning to their home villages in the haor from places such as Fazilpur, Bholiganj, Sylhet and Chittagong where they had gone earlier for work during the monsoon season.

In September large fish catches were reported. The traditional fishermen were fishing with a wide variety of gear. Some were also fishing in the rivers for big fish which were trying to migrate from the haors and *beels*. The large catches brought many seasonal fishermen into the haor. At the same time the leaseholders had again recruited *paharaders* to protect their *jalmohals*.

DRY SEASON

Kanda lands were used for grazing cattle starting in the middle of October, even though the grasses had not yet been able to properly reestablish themselves. Due to a scarcity of fodder, most of the farmers were grazing their cattle indiscriminately. At the beginning of the month, most farmers started carrying earth from the *kanda* to their homesteads with the help of boats. Some were immediately repairing their homesteads with the earth, while others are storing it for future use. Some people with *barki* boats hire themselves out to carry the soil. Almost all the people of Shanir Haor were preparing land adjacent to their homesteads for winter vegetables. Preparation of seedbeds for *boro* rice began at the end of October in some areas.

Fishermen were fishing in haor areas until 25 October. After that time however the presence of the *paharadars* made it very difficult to continue. During the last week of October a group of about 200 fishermen from Madhya Nagar were "gang fishing" in Dhawa Beel.

In the middle of November the harvest of *b.aman* began. Yields were lower than in the previous year. On average, the yield per *ker* was down by about 2-3 *maunds*. In the highland areas, preparation of seedbeds for *boro*, was almost finished. This year the different varieties included about 25% local *boro*, 65% *shail boro* and 10% HYV. In the low-lying areas the work of seedbed preparation started in the second week of November. Here the different varieties included 75% local *boro* and 25% *shail boro*.

The people of Marala had taken an initiative to protect the trees on the *kanda* between Marala and Nayanagar. Until January 1994, nobody was to cut any trees. *Hizal* and *koroch* trees which grow naturally have become quite large. Some saplings of *koroch* were planted at Gopalpur and Nayanagar.

By December the *paharadars* had tightened security around the *beels* preventing any local fishermen from entering. Some of the seasonal fishermen were fishing illegally in the *beel* areas adjacent to their villages. The traditional fishermen were mostly fishing in the rivers.

Harvesting of *t.aman* started at the beginning of December and was completed by the end of the month. *Boro* transplantation started in highland areas in the first week of December and was 60% complete by the end of the month. In these areas *shail boro* was transplanted in nearly 75% of the fields, *boro* in 20% and HYVs in 5%. Transplantation in low-lying areas started in the third week of December, and by the end of the month less than 10% was complete. There was a scarcity of water for land preparation and transplantation in the highland areas due to the rapid recession of water. On the other hand, this was good for low-lying areas which were able to work in their fields sooner. The people of Marala and Nayanagar were collecting *durba bon* and other grasses from the fields, in the adjacent Mohalia Haor.

Many migratory birds were found in the haor during the dry season. Some local households are involved in catching and selling the birds in the markets. The birds are caught with different types of traps and nets. The poor people collected cattle-dung and *bon* from the *kanda* to use as cooking fuel. Some of them also sold these to other villagers.

This year all available water bodies were used for irrigation. *Don* was the most common method of irrigation. Where land is located near a water body, farmers dug canals and brought water to the land by gravity flow. This system of irrigation is called *dhortula* - no equipment is required. In the first week of January, 77 haal (1 haal = 12 ker) of land were irrigated from Keuti Beel through the *dhortula* system. Water was available in this *beel* until February. To retain water in the Keuti Beel, farmers constructed small embankments in a few places. Similar systems were also seen in various other *beels* and *khals* in Shanir Haor. Dhawa Beel was the single largest source of water for *dhortula* system. About 800 ha of land were irrigated from this *beel*. However, in many parts of the haor, no irrigation was necessary as the occasional rainfall seemed adequate.

The *Beel* areas remained restricted to local fishermen through-out January. However, some of them continued to fish in the rivers while others fished illegally in the haor area. A group of fishermen negotiated with the *paharadars* to get access to the haor. Examination of catches at different floating fish markets indicates that about 100 kg (valued at around 50,000 taka) of fish are illegally harvested by the fishermen daily. *Bhasha* fishing in the haor started in the middle of January. Small fish are sold to local *nikari*. The leaseholders themselves carry large quantities of fish by engine boat to the markets in Sunamganj and Sylhet.

Other winter activities included the cultivation of vegetables; collection of *nara* (rice straw) *bajail, ikor, nolkhagra* and dry leaves of bamboo, *hizal* and *koroch* trees; excavation of *doba* by some labourers, women and children; boulder crushing by some women in the Fazilpur area (their wage was 40-45 taka/day); and pottery by some women in Palpara.

The amount of fish caught in February was down from the previous year. In large areas around the *khola*, fish are being dried to make *shutki*. The *khola* of Bogiani group fishery is a unique example of a fishing community within the Shanir Haor even though the engaged fishermen were hired from the outside of the haor. Members of the fishermen and their families are very active; their wage, or share, is based on their efficiency.

PRE-MONSOON

Heavy rainfall began on 20 March. On 28 March, parts of the embankment eroded and water entered the haor. People brought bamboo and *chatai* (bamboo mat), and offered their assistance

to help protect the embankment. The *boro* crop in some areas was inundated and people hurried to harvest their crop, even though it had not properly matured. The price of rice and other essentials increased. Many people ate sweet potato instead of rice.

Groups of *bepari* who came from outside the region to harvest the rice had trouble as many haors in the area had been flooded. Since the Shanir Haor remained mostly flood-free it had received an unusually high number of the *beparies*. Although many of them returned, those who stayed competed with each other to get the work in Shanir Haor and Halir Haor. Harvest of the *boro* started on 4 April. The yield was less than the previous year due to a poor distribution of rainfall - not enough rain when it was needed and too much rain when it was not needed. Those who cultivated the *shail boro* variety had an early harvest and were getting a good price.

This year, the number of people collecting *singra* was higher than previous years. For many poor people, *singra* constitutes the only meal of the day. Some people sold it in the market for 8-10 taka per kg. In April *koroch* branches and saplings worth 1,200 taka were sold from the Gopalpur grove by the mosque committee. The huts in the Bogiani fishing *khola* were dismantled during the first week of April.

A hailstorm in May damaged about 120 ha of *boro* crop on the eastern side of the haor. Cultivation of broadcast aman started in the highlands. The *beparies* left the area after the harvest.

In May many people were busy repairing their houses with straw and bamboo. People were using *chailla* for homestead protection. Some rich people are using boulders. Many people were collecting *kossom* from the haor to use as fuel.

5. EVALUATION OF PROJECT PERFORMANCE (1992-94)

5.1 Hydrological Data

To understand the hydraulic performance of Shanir Haor FCD Project during the PMP period of observation, 1992-94, water levels were recorded inside and outside the haor and hydrographs were prepared. Hydrological data for the project including Area/Volume - Elevation curves are presented in Appendix A.

5.2 Environmental Evaluation

Sedimentation: The greatest influencing factor on the sedimentation process and morphological changes in Shanir Haor and the surrounding area is the Jadukata River. It is a river that has high sediment loads and intense flooding. Typical for an alluvial fan the area is subject to constantly changing morphology. A slight change in the Jadukata at the border, 6 - 8 km away, would mean a significant change in the amount, and location, of sediment and flood water at Shanir Haor. In the past 30 years the greatest deposit of sediments have been in the north and east of the haor, close to the mouth of the Jadukata. However, if the Jadukata shifts into the Moharram River more sediment would be deposited in the northwestern region of Shanir Haor, the flows in the Baulai would increase and the flows in the Rakti would decrease. It is estimated that 43.7 million cubic meters of sediment has deposited in Shanir Haor in the past 30 years. But it is difficult to say how or if the Project has had any effect on increasing or decreasing this quantity.

Sedimentation and *parua* meadows: In the northeastern portion of the Shanir Haor the haor floor has been raised through gradual sedimentation. As a result, the water recedes earlier from this portion, making it favourable for the germination of grasses (*chailla*, *parua*, *erali*) as happened in 1992. Lavish growth was seen in that year. When the monsoon floods arrive these grasses are capable of growing along with the rising water levels. However, when there is an early flash-flood and this particular portion of the haor goes under water quickly (as occurred in February/March 1993), the grasses do not get a chance to grow. These meadows provide favourable habitat and shelter to waterfowl during the monsoon, when most of the area is under water. At the same time they cause local navigational problems. Because of these meadows, in 1992 waterfowl were observed even during the months of July-August when the rest of the area did not support any waterfowl (excepting Tangua Haor and Pashua Beel). Among the waterfowls seen in the area were Spotbill Duck, Little Cormorant and Whistling Ducks.

Embankments and crop pests: The embankments, as well as higher ground, provide shelter to rodents which are pests causing damage to the crops. Delayed arrival of flooding favours the increase of rodent populations. Early flooding (February-March) drowns many of the rodents while they are still in the paddy fields. Those which survive use the embankments and higher grounds in and around the homesteads for shelter.

Sudden water rise and plant germination: Flash-flooding of the haor negatively affects the germination process of water-tolerant trees and aquatic plants. February and March is when these plants germinate and establish themselves so that when the annual floods come in May/June they

are able elongate with the rising water level. However, if flooding occurs before germination has taken place the seeds remain dormant.

Embankment and fish migration/production: The project's embankments (and regulator) delays the migration of fish in and out of the haor during the pre-monsoon breeding period. This shortens the monsoon growth period and therefore reduces production. Embankments also restrict the access points to and from the haor for migrating fish. Fisherman cut the embankment at various points and then close off these cuts with nets. These nets then trap virtually all the broodstock during their migration. Therefore, embankments probably result in a greater mortality of broodstock and decreased reproductive success than if no embankment were present. The embankments decelerated late monsoon drainage and this results in stagnant water which increases the incidence of fish disease.

5.3 Social Evaluation

Agricultural production: Probably the greatest benefit of the Shanir Haor Project to the local people has been the increase in agricultural production. The project has made it possible to bring more land under cultivation and to provide some early flood protection to the *boro* crop.

Lack of inclusion of public in project institution: Voluntary public participation in the project is evident every time people assemble to close a breach in the embankment in order to save their crops or homesteads. This type of action would seem to indicate that the people are interested in participating in the project when they think that their intervention will bring benefits. However, at present there is no institutional mechanism to allow for the public to participate in a regular and meaningful way.

Public embankment cuts: There is no regular maintenance of the embankment and public cutting seems to be frequent. The reasons and timing of the cuts vary and one cut may serve a number of purposes. Of the 19 cuts which were observed at Shanir Haor in 1992, 14 of them included navigation as one of the purposes. Other cuts are made to catch fish or for drainage. The number and frequency of public cuts indicates clearly that the Shanir Haor Project falls short of meeting many important needs.

Loss of income in fisheries: The Project has decreased the fish production during the monsoon season. As a result local fishermen and poor people who can no longer survive from fishing are forced into seasonal migration out of the haor in search of employment.

5.4 Economic Evaluation

Inter-year Comparison of Primary Sectors

Economic evaluation data is summarized in Tables 5.1 to 5.3, and details are presented in Appendix H. Comparison of the net financial values of products from the three primary sectors (agriculture, fisheries and wetlands) in years 1 and 2 indicates that the total output value of Shanir Haor was 2.1% greater in Year 2 than in Year 1. Since most of the people who farm during the dry season also fish on a part-time basis during the monsoon season, the incomes from these two sectors are largely additive. The landless poor rely heavily on monsoon fishing and wetland product extraction for their livelihood, and thus are benefited more by higher flood intensities.

Table 5.1: Data Summary of Shanir Haor FCD Project - Year 1

Net Project Area (ha)	6,700		
AGRICULTURAL BENEFITS			
Net financial value - Tk 000	64245		
Cropping Intensity		0.8	
Average Gross Margins/ha - Tk		11602	
FISHERIES BENEFITS		**Flood plain**	**Beels**
Net financial value - Tk 000	10074	8629	1445
Total Production - 000 (kg)		510	58
Average Gross Margins (Tk/ha)		1292	3042
WETLAND IMPACTS			
Net financial value - Tk 000	9875		-
Average Gross Margins/ha - Tk		1479	-
NET ANNUAL INCOME - Tk 000	84195		

The economic evaluation suggests several important conclusions relevant to FCD project planning:

1) The fisheries and agriculture sectors complement one another in so far as a decrease in output from one sector is accompanied by an increase in output from the other. The net effect is to maintain total haor output within a relatively narrow range, and bestow a degree of flexibility and adaptability to variations in annual flood intensity.
2) High flood intensities result in a net increase in total haor output due to a strong positive response from the fisheries sector.
3) Wetland output is significant, and is approximately stable under a range of flood intensity conditions.

Each of the primary sectors is discussed below:

Agriculture: In year 1, agricultural products accounted for 76.3% of total haor outputs. The main source of income for farmers was local *boro* cultivation. In year 2, agricultural output declined by 5.0% due to a decrease in *boro* production. Non-cereal production remained almost constant. Although the cropping intensity was higher than the previous year, the net value of agriculture decreased. Early drainage enabled farmers to transplant more land but the yield was lower than the previous year due to crop damage. Some *boro* land was damaged due to breaches in the embankment and hailstorm in Shanirua Beel. As there was insufficient local data availability, the economic product values are based in part on (1) the crop and input prices (except labour and fertilizer), and (2) the per hectare input requirements (except irrigation) given in the FPCO guide lines. Livestock product value was not considered.

Table 5.2: Data Summary of Shanir Haor Project - Year 2

Net Project Area (ha)	6,700		
AGRICULTURAL BENEFITS			
Net financial value - Tk 000	6101645		
Cropping Intensity		1.0	
Average Gross Margins/ha - Tk		9586	
FISHERIES BENEFITS		**Flood plain**	**Beels**
Net financial value - Tk 000	15114	12934	2180
Total Production - 000 (kg)		590	78
Average Gross Margins (Tk/ha)		1937	4589
WETLAND IMPACTS			
Net financial value - Tk 000	9833		-
Average Gross Margins/ha - Tk		1473	-
NET ANNUAL INCOME - Tk 000	85963		

Table 5.3: Comparison of Net Financial Output Values from Shanir Haor Project

Sector	Year 1		Year 2		Incremental Value (Year 2 - Year 1)	
	Tk 000	**%**	**Tk 000**	**%**	**Tk 000**	**%**
Agriculture	64,245	76.3%	61,016	71.0%	- 3,229	- 5.0%
Fisheries	10,074	12.0%	15,114	17.6%	+ 5,040	+ 50.0%
Wetland	9,875	11.7%	9,833	11.4%	- 42	- 0.4%
TOTAL	84,195	100.0%	85,963	100.0%	+ 1,768	+ 2.1%
Flood intensity (mcm-months)	1,195		1,469		+ 274	+ 22.9%

Fisheries: In year 1, fisheries products accounted for 12.0% of total haor outputs. More than 80% of fish production originated from the monsoon flood fisheries. In year 2, fisheries output increased by 50.0%, probably due to higher flood intensity and improved fish migration opportunities.

Wetland: The wetland product output remained almost constant over the two years (a slight decline of 0.4% occurred in year 2). Delayed flooding in year 1 facilitated an increased extraction of plant products, while early flash-floods in year 2 arrested the growth of several wetland species. Low yields were recorded for several plant products (*khai, parua, singra* and *chailla*). It was not possible to accurately estimate the total utilization of wetland products. Many products were not included in the analysis. Moreover, many wetland products, like medicinal plants, food, fencing materials, bio-fertilizers, and fish baits are extracted according to the level of need which varies from year to year and may not be a direct function of the level of resource abundance. No records are kept, and production could not be readily quantified. Many of these products do not have established trade values. Despite these quantification constraints, available evidence suggests that wetland products have a significant economic importance in the project area.

The contribution of the three main primary sectors (agriculture, fisheries, and wetlands) to the total Shanir Haor output are presented graphically in four figures:

Figure 11: Net Financial value of each of the three sectors

Figure 12: Average Gross Margins for the three sectors

Figure 13: Flood Intensity and net financial value

Figure 14: Comparison of relative contribution of the three primary sectors to the total net financial Haor output

These figures (Figures 11 to 14) are presented in Appendix I at the back of the report.

6. RECOMMENDATIONS FOR IMPROVEMENT OF SHANIR HAOR FCD PROJECT

6.1 Public Participation

Institutional arrangements to facilitate public participation should be made. This should be done through a beneficiaries' committee for operation and maintenance. Such a committee should be formed by the beneficiaries and may be termed a Project Committee.

At the present time the operation and maintenance of the project infrastructure is the responsibility of the BWDB. However, local people take many initiatives to "operate" the infrastructure - mainly the embankment - to meet their own particular needs. Sometimes such initiatives which are beneficial to one group, may be destructive to the interests of another group. For example, the cutting of embankment by boatmen to allow their boats to pass may negatively affect farmers whose crops would be inundated. Maintenance is also done by the local people but only on an as-needed basis. In an emergency situation, when crops or property are in danger, the impacted people will make impromptu repairs to the embankment. The effectiveness of the infrastructure could be improved, and the negative consequences of some local initiatives could be minimized if the participation of the impacted people were institutionalised.

6.2 Engineering

Embankments and Compartmental Bunds

To protect Shanir Haor from early flood, the following measures have been recommended by various communities:

- The height of the embankment between Nayabarunka and Sripur, on the north side of the haor, needs to be increased by one metre. This part of the embankment is overtopped by flood water at the time of harvest (April-May) and damages the crop.

- The four compartmental bundhs in the haor need to be strengthened and their height should be increased. When the outer embankments are breached the compartmental bundhs could act as a second line of defence.

Drainage Works

The following improvements are recommended by local people:

- A second regulator should be constructed at Ahmokkhali. The embankment is cut here every year as this seems to be the major drainage outlet for the haor. However, after the cut is closed, it remains a weak point in the embankment and vulnerable to flash-floods.

- A third regulator should be constructed on Beheli Khal. Here the embankment is also cut by the farmers almost every year for drainage. This *khal* drains the eastern/southeastern portion of the haor.

- The box culvert at Atlachatol should be repaired to improve internal drainage.

- The Bogiani Khal needs to be re-excavated.
- The internal network of smaller canals should be improved to facilitate better drainage.
- The *jangal* of Dhawa Beel from Anwarpur to Anantapur and from Anantapur to Puran Barunka should be properly maintained. If this *jangal* is properly maintained, then most of the agricultural plots in the area could be irrigated.

Fishpasses
In order to permit timely migration of fish during the pre-monsoon breeding season, consideration should be given to constructing a fishpass beside the Bogiani Regulator. This will depend, in part, on the results of the pilot test fishpass project which is planned for 1994/97.

Navigation
The existing water transportation infrastructure needs to be repaired and additional facilities need to be created to improve transportation efficiency in and around Shanir Haor. Recommendations in this connection include the following:

a) Construction of two navigation passes in the project embankment to provide for easy passage of country boats. To efficiently bring the agricultural inputs into, and the produce out of the haor, access by country boats is essential. The present regulator is not sufficient since the gates are not wide enough to pass the larger boats, and the regulator sill is not deep enough for boats to pass in the dry season.

b) Excavation of new internal canal network. The present canals inside the haor provide both internal transportation and drainage. But in their present state they cannot properly fulfil either of these tasks. The existing canals need to be re-excavated and new canals need to be added to make the transportation and drainage network in the haor more efficient.

c) Dredging of the Rakti River is also required, as detailed in the NERP pre-feasibility report entitled: *Jadukata-Rakti River Improvement Project*.

6.3 Agriculture

Land Ownership and Tenancy
A limit on rental payments and interest rates would provide an economic incentive for tenants to use improved agricultural technologies.

Credit
A special credit system should be developed for farmers that would provide them with easy access to loans. Availability of credit is one of the key factors for increasing agricultural production in the project area. Short term, crop production loans should be available for seasonal agricultural operations, and medium term loans for capital investment. Crop production loans should include funds for fertilizers, seeds and some cash money for labour costs.

Crop Selection
There is a need to develop new rice varieties that are quick-maturing, cold weather tolerant, and with high yield potential which can replace existing local *boro* varieties. Also, high yielding

deepwater *aman* varieties need to be developed which can be transplanted. Suitable *rabi* crops should be introduced which can be grown before the HYV *boro* is transplanted.

The areas where winter vegetables are grown, on the higher ridges, could be increased with proper irrigation facilities. Studies are required to look into the preservation of vegetables with the view to possibly preserving them for six months for consumption in the monsoon season, when vegetables are not available locally.

Consideration should be given to the production of rice herbage as cattle feed. Studies are required on the use of deepwater *aman* herbage and the effects on yield. Deepwater *aman* has vigorous regaining ability during the vegetative phase (in the monsoon season) when there is an acute shortage of fodder in the haor. Leaves can be pruned and utilized as cattle feed.

Studies are needed on controlling weeds, and on the potential of the weeds as livestock fodder, feed and green manure.

Storing and Marketing Produce
There is a need to promote cooperative and group marketing of produce. The supply of marketing information could help in providing alternative marketing channels to the farmers. The need for an improved crop marketing system should be reviewed.

Agriculture Services
The Department of Agricultural Extension should play an active role through *thana* agricultural extension activities to improve agricultural production. Cultivation practices, irrigation management and input use need to be improved through farmer training, monitoring, surveys and studies. A pilot project should be undertaken to solve field level problems.

Formation of Agricultural Units
The development of farmers' groups and associations to promote the mutual interests of farmers and increase productivity is needed. The groups, or association would select representatives to manage the project, arrange credit and work for loan recovery.

Livestock
Livestock extension services should be strengthened. An increase in the production of cattle forage is required. Rice herbage can be produced in the deepwater *aman* area. More forage production, together with better livestock management, can improve draught animal supply, dairy production and family farm incomes. The interaction between crops and livestock needs to be enhanced and diversified.

A regular vaccination program would encourage farmers to take up duck farming on a larger scale. Duck eggs are in high demand in the project area. Itinerant traders frequently visit the area to purchase poultry eggs.

6.4 Fisheries

Allocation of Fishing Rights
Leasing of *jalmohals* to outsiders who are non-fishermen should be stopped. Dry season fishing rights to a particular *jalmohal* should be granted only to the fishing community(ies) living

adjacent to the area as the local fisherman have longterm interests in sustaining the openwater fisheries resource. Subsistence fishing during the monsoon season should be open to the entire haor population. Part-time fishermen should be allowed to fish without harassment from *paharadars*.

Provision of credit
A system of credit for fishermen to buy gear and boats needs to be introduced. This could be on a revolving fund basis.

Controlling Destructive Fishing Methods
The use of certain fishing gears which are resource destructive should be prohibited. The use of fine meshed net like *kona jal* destroys a large portion of the fry, resulting in a decline in production. Current nets exert a similar destructive effect on the larger size fish. Measures to control such destructive fishing should include public awareness programs, organization of fishermen's committees, and formulating and enforcing the necessary legislation.

Dewatering
The practice of complete dewatering of the *beels* to catch fish needs to be stopped. This practice destroys the entire fish population of the *beel*, including the broodstock. As a result in the following years there is a significant decline in production.

Annual Pile Fishing
The practice of harvesting *katha* piles annually should be stopped, and the three year pile harvesting system made mandatory for this fishing system. The annual pile harvesting system has caused the number of large fish to decline rapidly through out the region.

Protection of Broodstock
A closed season on fishing should be enforced to protect broodstock during the spawning period (pre-monsoon season). This ban would include fishing through cuts made in the embankments and *ujaiya* fishing.

Improved Processing and Marketing of Fish
There is a need to introduce improved fish processing methods in Shanir Haor, including drying and icing of fish. Improved methods for keeping and transporting live fish to distant markets also needs to be developed.

6.5 Villages

Flood-Proofing Homestead Mounds
Villages platforms which are vulnerable to inundation by floods should be raised. In Shanir Haor, the level of the platforms in many villages is lower than the highest flood level. The following villages need particular attention in this respect:

Sripur Union: Shahebnagar, Marala, Gopalpur, Nayanagar.
Beheli Union: Radhanagar (western side)

Many village platforms are also vulnerable to erosion by wave action during the monsoon season. Although the villages already take some protective measures a more extensive strategy is needed.

Afforestation of *hizal* and *koroch* trees around these villages would be useful in this respect. The following villages are particularly vulnerable to erosion:

Beheli Union: Radhanagar, Islampur, Shibpur.
Tahirpur Union: Shahaganj, Bhati, Tahirpur.
Sripur Union: Sripur.

Domestic water supply
There should be at least one public tube-well in each *hati* of the village for domestic water consumption. For selecting appropriate location of the tube-well and its maintenance, a tube-well committee should be formed by the users. This committee should function under the guidance of the sponsoring agency, that is, the Department of Public Health Engineering (DPHE) and the local government.

Improved sanitation
The existing programme of the DPHE for sanitation should be extended so that all households are covered. All households should receive adequate training for the use and maintenance of water-sealed latrines and should receive a slab-ring at the subsidized price. Planned raising/extension of homestead platforms should be promoted by the public authority to allow adequate space for water-sealed latrines in villages where there is a severe lack of space. This programme could be jointly implemented by DPHE, LGED and local NGOs.

Social services
Primary health care infrastructure should be extended to cover all households in the villages. This needs mobile medical units in the field with adequate supplies. These units should visit households under their jurisdiction regularly on specific days. All households should be covered under the existing programme on immunization against six common diseases (EPI). The Directorate of Public Health in collaboration with the local government should prepare and maintain birth registers and immunization records and organize immunization field camps more frequently. There should be at least one primary school in every village, and in every *hati* of the bigger villages, so that it is accessible to all children in all seasons.

6.6 Environment

Afforestation
Support should be given to private initiatives of planting native water tolerant tree species (*hizal, koroch, borun, biyash*). Planting new forest stands should be encouraged as they protect homesteads from wave action during floods, act as wind breakers during storms and stabilize higher ground by inducing sedimentation. Additionally, such plantations will provide some income through the selling of tree branches for housing, fuel, and for *katha* fishing. Educational programmes on the need for afforestation and maintenance of forest stands and homestead groves should be initiated.

Harvesting Wild Plants
A multi-component programme of wild plant management and utilization should be initiated. It would focus on the following major natural plant resources:

Chailla. This grass is collected by the local people and used as a barrier around their homesteads to protect against erosion from wave action during the ensuing monsoon floods. The cost of using *chailla* is a lot less than using stone. However the grasses need to be replaced each year whereas the stones last many years. The grass is preferred by the locals as it can also be used for fodder and fuel. Over exploitation of the species might endanger its future availability, so there is a need to monitor its rate of exploitation.

Parua. This plant is sometimes considered a nuisance since profuse growth hinders local navigation within the haor. However, the problem is considered man-made. Delayed arrival of water in the haor due to submersible embankment allows the grass to spread and grow. The grass has various uses as fodder, fuel and thatching. Finding more methods of utilization would keep the population under control. And keeping the navigational routes free from these grasses will bring few complaints.

Singra. The fruit of this plant is collected for consumption but is also traded. It is mostly consumed by the local people during times of hardships when regular food sources are scarce. Research on improving the size, quality, and production of this important aquatic plant could be of great benefit especially to the poorer people who are more dependant on it.

Ghechu. This plant is collected locally. The corm which is tuberous and rich in carbohydrates [as well as having 7-9% protein (Islam, Q.R. In Press. 1994)] is also consumed when regular food sources are scarce. It is eaten in various forms: roasted, boiled, and raw. Several species of this plant occur in the haor. Research initiatives to increase corm size will increase its production potential. It could be planted as a cash crop in the wetland areas by the local people.

Shaluk/dheb. The fruit of this plant, *dheb*, is a common source of food at times of hardship, and is also sold in local markets. It is eaten as a vegetable, and is a good source of starch. The plant is also used for medicinal purposes, and for fodder and bio-gas. The fruit is highly prized because it is used in making delicacies. Enhancing the production of this plant will benefit the low income people who collect it.

Kola phal. This fruit is less abundant in the haor than the previously mentioned plants. This plant grows in shallow areas; most of which have been converted to cultivable land. The fruit is used as a vegetable and eaten raw and the seeds are used in making delicacies.

Murta. This plant has the potential for being an important cash crop because of its great demand in cottage industries for mat making. It grows naturally on the *kandas* and around homesteads but can be artificially manipulated for enhancing production.

A system for proper accounting of the wetland products through actual valuation or replacement values needs to be developed, otherwise the economic returns from this dynamic and productive ecosystem can not be verified.

Harvesting Wild Animals

Frogs. Some amphibian species are commercially important like *sona bang*. Due to widespread capturing and commercialization in the past, the population has declined. It is presently illegal to capture and export frogs or froglegs. But still some amount is exported clandestinely and some collection continues in Shanir Haor. The young ones of several species, including *kotkoti bang*,

sona bang, and *kuno bang,* are used as bait. Artificial rearing programmes can provide employment and income to the local people.

Turtles. Freshwater turtles are consumed locally and also exported. There is a great demand for turtle meat/oil. Local fishermen catch turtles using nets or fishing lines. Captive breeding programmes could be initiated to enhance production and local employment can be generated.

Waterfowl. During winter migratory waterfowl are a great attraction for the local people as well as outsiders who visit the haor. Several people are involved in trapping migratory ducks for commercial reasons. There is a need to check the trapping because some of the species are endangered and face global extinction. These waterfowl are increasing the biomass production of the wetland by depositing the highly nitrogenous excreta in the water. Protection measures need to be taken against illegal hunting and trapping.

Hunting and Protection of Wildlife

Most of the wildlife is gone from the area and what remains has either been ignored for religious or social reasons, or is of little commercial value. A few wildlife species, however, draw a lot of attention and are extensively utilized. Special programmes highlighting the values and services provided by wildlife should be initiated and the Wildlife Preservation Act should be better publicized. Captive breeding programmes of some commercially important wildlife species (monitor lizard, freshwater turtles, otters) could be initiated which would provide employment opportunities for the local people and would create a sense of caring for the remaining wild animal resource.

Enhancing Biodiversity

Alternatives to dependency on rice production should be studied involving different ecological habitats and varied activities. The proliferation of the diverse wetland flora and fauna depends on a number of factors most of which are now dictated, or heavily controlled by man through the Project's infrastructure. Improving the present ecological situation demands cooperation from all quarters but most significantly it requires improvement and development in the education and economic sectors.

Conservation, including managerial aspects, of the habitat and the animals dependent on it automatically leads to optimum utilization of wild resources and ensures their future perpetuity and leaves recovery space for biodiversity. Lack of management plans often imbalances the environment and imposes deleterious affects on the nature and natural resources. Developing management and restoration plans for the heavily exploited wetland resources and degraded habitats with employment opportunities for the local people will lead to better resource utilization practices as well as to maximize proliferation of other species.

6.7 Planning and Implementing a Multisectoral Development Programme for Shanir Haor

In order to achieve multi-sectoral development, a workable mechanism has to be devised. This requires an institutional arrangement encompassing all sectors of the local economy and all strata of the impacted population. This idea is essentially linked with the local level planning process. This calls for the strengthening of the local government institutions (the UP), and its horizontal linkage with specialized agencies (BWDB, DAE, DOF, DLS, etc). One solution would be to have adequate numbers of extension staff of these agencies at the union level who would work

in close cooperation with the UP and the project beneficiaries. A Project Committee would be formed comprising representative of the beneficiaries and these agencies at the project level. This framework should include the following:

- An integrated approach to management of natural resources for optimizing aggregate benefits from agriculture, fisheries, forestry, livestock and other homestead-based activities;
- Adequate protection of human settlements in order to facilitate homestead-based economic activities, as well as to provide safe shelter and improved quality of life;
- Improvement in water quality, particularly drinking water, by providing access to safe water for all;
- Improved sanitation by appropriate settlement planning practices and disposal of waste with acceptable sanitary standards;
- Developing flood preparedness infrastructure including raising of homestead platforms, afforestation for protection of homesteads, construction of flood shelters, provision for emergency storage for essentials and water supply;
- Developing primary health care infrastructure to deal with common diseases and to respond to emergencies, particularly at the time of flood;
- Developing infrastructure for universal education, at least up to the primary level;
- To facilitate local level planning in order to ensure public participation in all concerned matters.

7. FUTURE PARTIAL FLOOD CONTROL PROJECTS

7.1 Project planning process

Local Level Planning Process

Participation of the impacted people is increasingly being recognized as a key element for successful implementation of any development initiative. The people need to be involved not merely after implementation of a project, but more at the planning stage. A successful planning strategy should evolve around the following:

- Demand for interventions by the people themselves;
- Scrutiny of all possible options proposed by the people or in consultation with the people;
- Scrutiny of all positive and negative impacts on different sections of the population that are expected to result from the implementation of a project;
- Dialogue between different sections of the population having different or conflicting interest in order to have a decision preferably on the basis of general consensus;
- Ownership of the project by the people so that they take care of the infrastructure.

To evolve such a strategy, development efforts should be integrated with the local level planning process through strengthening existing local government institutions. The workable arrangement may encompass, among others, the following:

- A project committee should participate in decision-making in all phases of the project; that is, in planning, construction and maintenance.
- This committee, as a statutory body of the impacted people, should own the project and participate in the financing of construction, operation, and maintenance.
- An effective horizontal linkage between this committee and all concerned specialized agencies should be established through necessary administrative reforms.

Defining Project Objectives

A broad approach to defining project objectives needs to taken. The aquatic environment of the haor area has a substantive comparative advantage in terms of production of fish, ducks and wetland products. The local rice varieties are well suited to the agro-hydraulic regime. The wetlands environment creates a good habitat for many submerged and rooted floating plants. Over one hundred fish species have been identified in the area. Some of the aquatic plant and fish species are endemic. Future partial flood control projects should be designed considering the environment in this area as a whole. With partial flood control the present farming systems must be improved and diversified, taking advantage of the aquatic environment. Promising opportunities include the development of improved local rice varieties and cropping systems, more intensive livestock production, greater duck production, better fisheries management and post production facilities, and increased production of wetland products. As a significant part

of the total haor area goes under water for a major part of the year its suitability for fisheries can hardly be questioned. Future FCD projects should be designed and planned on the basis of consideration of all resource available (actual and potential) within and outside the prescribed project area. High risk areas for crop agriculture (low elevation areas adjacent to beels) should be carefully reviewed as regards any agricultural development initiatives and provision for fisheries development should be ensured. The production of natural commodities, either high in commercial value or high in food security/survival value for poor people, should not be placed in jeopardy by project infrastructure.

Baseline Field Studies
Comprehensive studies should be carried out for potential solutions and strategies for the use of natural resources in a sustainable and environmentally sound way. The studies should focus on closer integration of crops, livestock, fish and multipurpose trees in farming systems. Socio-economic issues, especially access to production factors such as land, credit and farming inputs must be fully addressed. This would help to identify promising farm enterprises.

Infrastructure, natural resources, people's involvement and interests, socioeconomic trends, and hydrological constraints should be studied extensively. Farmers, fishermen and other professional interests should be studied including alternative opportunities relating to the project initiatives. Local people should be involved in each stage of study or implementation of the project so that each interest group becomes motivated to participate in development work. Particularly for fishing communities, provision should be made for the local fishermen to gain sole legal access to the fisheries within the project area in order to create conditions for improvement of the fisheries over the long term.

7.2 Model of an idealized FCD project

Embankments
Submerged embankment prevents partial flooding. People should be motivated towards partial flooding since inflow of flood water increases high fertility of land. The alignment of the embankment shall be accepted by the project people. This will reduce the cutting of embankments and social conflict. People outside the embankment should generally be re-located inside the project area.

For a partial flood control project usually submersible embankments are built to afford protection during the pre-monsoon flood; thereafter they are overtopped and remain submerged during the monsoon season. These submersible embankments reduce pre-monsoon crop damages, and internal roads are less affected. During monsoon peripheral regulators should be open to allow river water to freely enter the project area. The openings of the regulators reduce the head difference across the embankment and therefore reduces damage to the embankments.

A major consideration for embankment design is the selection of the magnitude of flood flows, corresponding flood level, and their frequency of occurrence. The latter depends on the degree of protection desired. Whatever may be the degree of protection, an embankment must be safe and stable during all phases of construction and operation. The body of the embankment must remain stable against external forces and foundation failure during normal and critical conditions of loadings. The alignment of embankment is governed mainly by technical,socio-economic and morphological considerations. Economically the best alignment is that which can be built as

efficiently and cheaply as possible i.e, which requires the least land acquisition and minimum quantities of earthworks. Set back distance shall be fixed carefully by considering scouring of the river bank, and the tendency of the river to move towards the planned embankment. The alignment shall not pass over any sub-soil comprised of peat or organic soils. Where possible, abrupt changes of alignment shall be avoided especially at locations which are vulnerable to severe erosion. Where embankment are to be provided on both sides of a river, the minimum set back distance shall be determined from the floodway requirement to pass designed flood under confined conditions.

Regulators and Drainage Structures

River flooding will be prevented by peripheral embankments, and internal runoff generated due to rainfall will be drained out through sluices when the outside river stages permits gravity drainage. Three periods can be recognized in the context of drainage : pre-monsoon, monsoon, and post-monsoon. Free gravity drainage is usually possible during the pre-monsoon and post-monsoon seasons.

The runoff from the drainage compartment will be conveyed by the tertiary,secondary, and main drainage canals to the lower elevations behind the regulators. The drainage system should have adequate capacity to provide effective drainage during the pre-monsoon period when gravity drainage would normally be possible. The capacity for effective drainage during the monsoon would not be normally a design consideration since gravity drainage is impeded by high river levels. However, the capacity of the regulators to provide satisfactory post-monsoon drainage is an important consideration. The basic considerations for setting up regulators are: (1) during the pre-monsoon season crops shall not be submerged for a period which can cause damage, (2) during the post-monsoon season water should drain from the project area within a stipulated time so that agricultural activities are not delayed, and (3) the head difference across the regulator shall be within limits when the gates are opened.

Flushing requirements at peripheral embankment regulators should be investigated separately for each specific structure. If flushing is feasible a haor side stilling basin is to be provided. Where flushing is not feasible, however, provision of an apron on the haor side is necessary.

Fishpasses

During the planning phase of any FCD project in the haor area consideration should be given to providing opportunities for keeping existing fish migration routes open and functional. If crop protection requirements are such that the project regulator(s) cannot be opened during the early migration period, a suitable fish pass should be installed. A pilot test fishpass project is to be carried out in the Northeast Region starting in 1994. The results of this test project should be used in future fishpass design. A multi-sectoral team should be formed to deal with any problems arising from the operation of the fishpass.

Navigation Passes and Transportation

The improvement of the existing navigation infrastructures and development of additional facilities is important for partial flood control projects, including the construction of appropriately located navigation passes. A program of re-excavation of the internal access canals should also be carried out to make interior points of a project easily accessible. A program of re-excavation of rivers that connect the project to other areas in order to ensure year round navigation and communication will often be necessary. The costing of the navigation improvement should be balanced against the benefit to be derived from the project. Improvement of waterways is

complementary to agriculture, drainage, flood control, fish production, and therefore, flood control projects should be integrated with navigation.

Environmental components

Problems of siltation in rivers or on floodplains are usually not the result of a local problem. Rather it is changes in the river system many miles upstream or downstream. The natural environment in the Northeast Region, and the Haor Area particularly, is very unstable. The river network is constantly changing and adjusting. Often these changes occur slowly over a number of years but sometimes they occur suddenly and violently. Future submersible embankment project should consider this and allow the project to change and adjust with the river system.

All partial flood control projects need to incorporate programmes in social forestry, wild plant and wildlife management, utilization and conservation. Impact assessment and continued monitoring programmes of biodiversity and wetland products need to be undertaken. Awareness building should be initiated through non-formal environmental education programmes. Audio-visual programmes and reading materials would help at the initial stages.

Social components

In order to facilitate effective functioning of the infrastructure and to optimize aggregate benefits, the partial flood control projects should have adequate provision for the following:

(a) Needs assessment: There should be a process of continuous assessment of the need, such as, when water is needed and to what extent, when water needs to be drained out and to what extent it should be retained for fishing or transplantation, and so on. An activity calendar based on existing practices with some element of flexibility responding to emergencies should be devised and maintained by the group who are responsible for delivering services. A representative Project Committee or the local government, or a mix of the both can do this.

(b) Conflict resolution: It is likely that there would be conflict of interests among different sections of beneficiaries on the one hand and between the beneficiaries and the dis-beneficiaries on the other even under a 'best-possible' system. For example, there may be simultaneous need for drainage and irrigation by sections of farmers and fishermen. Appropriate institutional arrangements at the local level are necessary so that all such conflicts are handled carefully in order to attain maximum possible benefits from the infrastructure.

(c) Management: Technical functions which necessitate the presence of professionals of any concerned agency should be performed by the specialized agency in consultation with the beneficiaries of the project. The people should be brought into the core of local level management. The project should belong to the people in every sense of the term.

Economic components

Beneficiaries of the project should pay for the services they receive from the project. Separate funds for operation and maintenance should be created to meet the expenses. Financial participation of the people would give them a sense of belonging and consequently they would feel obligated to take care of the infrastructure. The people who are negatively impacted by the project in its day to day operation should receive adequate compensation from this fund.

Alternate job options should be created for the people who are negatively impacted by the project in its day to day operation. High efficiency improved crop marketing system should be established. For all FCD projects there should be a data collection system in order to record the project impacts.

7.3 Project operation and maintenance

A project committee as outlined earlier should be responsible for operation and maintenance of the project using its own resources. Certain technical functions will need to be performed by persons and institutions possessing the required skill and experience. In this context, the relationship between the project committee and the concerned specialized agency should be defined. It would be useful if members of the specialized agencies become part of the project committee.

For a partial flood control project, during monsoon the regulator gates shall be opened when the head difference across the embankment is at a minimum in order to prevent breaching of submersible embankments. During post-monsoon when the inside water level becomes higher than the surrounding river water level, the gates shall be opened to allow for draining. At pre-monsoon if project water level becomes higher than the river water level due to rainfall causing flooding in the project area, the gate shall be opened. The inlet and outlet channel of structures, and drainage channel system shall be re-excavated if silted up during the flood period. Any damages caused to the embankments by the rising flood waters needs to be repaired in the post monsoon season.

7.4 Impact monitoring and continual optimization

The representative Project Committee should be made responsible for routine monitoring of the project pertaining to the following:

- Functioning of the infrastructure;
- Performance of the impacted economic activities;
- Management practices;
- Livelihood pattern of the people;
- Social institutions and processes;
- Conflict resolution.

Guidelines for optimizing project benefits will evolve from routine monitoring. There should be an in-built mechanism to share and transmit the results of monitoring to concerned agencies and the beneficiaries for review and adaptation.

For each FCD project, the BWDB should have a program to monitor hydrological changes both inside and outside of the project, so that other GOB Departments can use this data in their own sectoral monitoring studies. Because fisheries is an economic sector that is completely water resource-determined, it would be most useful to analyse the changes in fish production by comparison with changes in flood intensity from year to year. Fish size and species diversity should be monitored by the DOF along with changes in floodplain and beel production levels and fishing effort.

The PMP study clearly indicates that a submersible embankment FCD project is never 'finished', whereas a bridge project, for example, is considered finished once construction is complete and the bridge is put into commission. FCD projects create artificial environments (with more or less success) which attempt to meet a complexity of human needs, and at the same time create other complexes of negative impacts. An FCD project is thus at any point in time always far from being perfect (this axiom is easily supported by the number of complaints that are levelled against FCD projects throughout the region by project area residents). The imperfections may originate in part from faulty initial planning and design - most often from ignoring the needs of some of the impacted area resident groups, and failing to select development objectives which address all economic sectors. However, other imperfections arise after the project has been commissioned:

- Partly from unpredictable changes in remote variables (rainfall, affluent discharge, land use and other developments in the catchment area), and

- Partly from changes in the needs and development objectives of project area residents themselves, as they respond to the ever changing mix of regional, national and international social and economic driving forces.

Under such pressure, a FCD project cannot remain a static item of infrastructure, but must undergo a continuous process of evaluation and modification (through new constructions and decommissioning of redundant structures) in order to optimize its outputs and impacts in the short and medium term future. The role of users in project ownership and management will similarly not remain static. Institutional flexibility and local initiative will likely remain the keys to achieving continuous project success.

APPENDIX A

HYDROLOGICAL DATA

APPENDIX A : HYDROLOGICAL DATA

AREA/VOLUME-ELEVATION CURVES FOR SHANIR HAOR

Every year a seasonal lake forms in Shanir Haor. It begins to fill in the pre-monsoon season mainly as a result of inflow from the surrounding rivers, and at the height of the wet season it normally occupies the entire haor area except for the high village mounds. It begins to empty in the post-monsoon season mainly as a result of outflow to the surrounding rivers, and at the height of the dry season it normally occupies no haor area except for the lower beel bottoms.

For modelling the hydraulic operation of Shanir Haor, and for several other purposes, the relationships between the lake area A and its surface elevation H, and between the lake volume V and its surface elevation H, are needed; these relationships, or curves, can be expressed as:

$$A = f_1(H) \tag{1}$$

$$V = f_2(H) \tag{2}$$

Function (1) is derived from maps defining the topography of the haor ground surface, and Function (2) is derived from Function (1) using:

$$V_2 = V_1 + ((A_1+A_2)/2)(H_2-H_1) \tag{3}$$

wherein the subscripts attached to A and V indicate they are the values corresponding to H_1 and H_2.

The only available large-scale topographic mapping of Shanir Haor is that published by the SOB in 1964 at scales of 1:50,000, and 4" = 1 mile. Several hundred irregularly distributed spot heights are shown on these maps except over the beel areas for which none are given; these beel areas total 1341 ha, or 17.3% of the total haor area of 7761 ha.

In the 1980s the MPO extracted from these maps ground elevations at the intersection points of a 1 km square grid. These grid elevations (only 73 in number for Shanir Haor) were used by NERP to develop the area-elevation curve, Function (1), shown in Figure 1 as Curve A, and this curve was used in early work on modelling the hydraulic operation of Shanir Haor. Since this curve was derived from ground elevations pertaining in 1964 (almost 30 years ago) its validity for use in modelling hydraulic operation of the haor in 1992-94 was suspect due to the possibility of heavy sedimentation in the haor during the intervening years.

In 1993 Halcrow (consultant to BWDB for its SRP) re-surveyed Shanir Haor, and developed the area-elevation curve shown in Figure 1 as Curve B. Curve B has been preferred in current work on modelling the hydraulic operation of Shanir Haor.

Halcrow also developed an area-elevation curve for 1964 based on all spot heights shown on the 1964 SOB mapping, and supplementary spot heights taken from a Department of Fisheries survey of the 1341 ha beels area carried out in about the same year. This curve is shown in Figure 1 as Curve C, and it is clearly substantially below both Curves A and B. The differences between Curves A and C are thought attributable to the considerable difference in the densities of spot height data used in their derivation.

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Summary tabulations of the area/volume-elevation curves are given in Table A1 (1964, Curve C) and A2 (1993, Curve B). Tables A3 (1964, Curve C) and A4 (1993, Curve B) present interpolation formulae required to obtain areas and volumes at elevations intermediate between those listed in Tables A1 and A2. An extended version of Table A2, based on the interpolation formulae of Table A4, is available for the elevation range 1.11 m PWD to 9 m PWD at 1 cm intervals, and a similarly extended version of Table A1 could be prepared if required on the basis of Table A3.

Shanir Haor Project

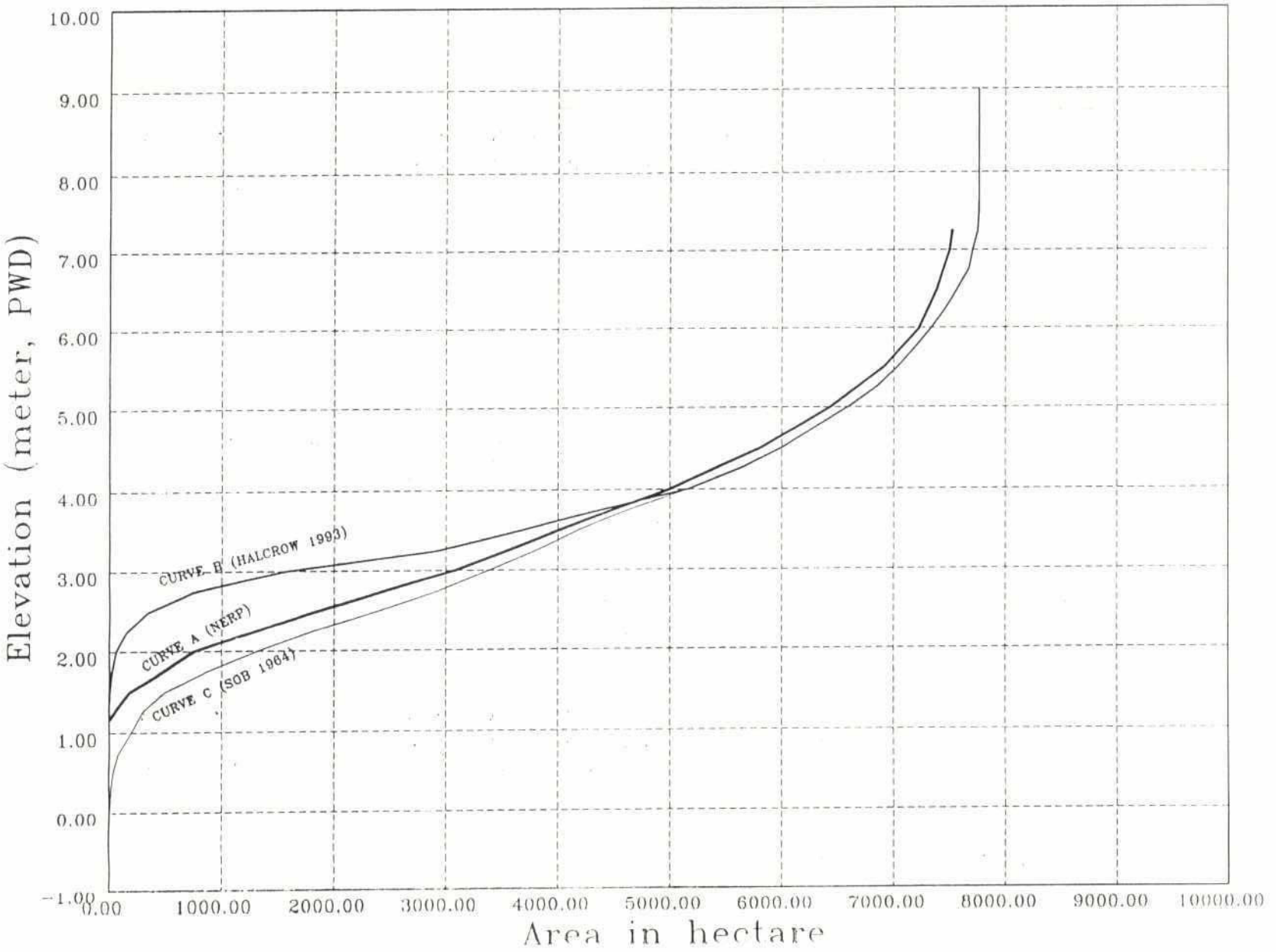


Figure 1

Table A1

AREA–ELEVATION AND VOLUME–ELEVATION CURVES FOR SHANIR HAOR, 1964 (SOB MAPPING)

Elevation (m PWD)	Area ha	Volume m3
−0.25	0.00	0
0.00	4.00	5,000
0.25	20.00	35,000
0.50	40.00	110,000
0.75	80.00	260,000
1.00	200.00	610,000
1.25	300.00	1,235,000
1.50	500.00	2,235,000
1.75	850.00	3,922,500
2.00	1,325.00	6,641,250
2.25	1,800.00	10,547,500
2.50	2,382.56	15,775,700
2.75	2,931.35	22,418,088
3.00	3,391.69	30,321,888
3.25	3,801.45	39,313,313
3.50	4,190.45	49,303,188
3.75	4,638.42	60,339,275
4.00	5,155.97	72,582,263
4.25	5,626.52	86,060,375
4.50	6,003.30	100,597,650
4.75	6,288.29	115,962,138
5.00	6,596.82	132,068,525
5.25	6,843.75	148,869,238
5.50	7,035.02	166,217,700
5.75	7,191.51	184,000,863
6.00	7,333.21	202,156,763
6.25	7,460.41	220,648,788
6.50	7,563.37	239,428,513
6.75	7,666.83	258,466,263
7.00	7,701.73	277,676,963
7.25	7,747.15	296,988,062
7.50	7,758.54	316,370,175
7.75	7,759.64	335,767,900
8.00	7760.31	355,167,837
8.25	7760.62	374,569,000
8.50	7760.83	393,970,812
8.75	7760.96	413,373,050
9.00	7761.00	432,775,500

Table A2

AREA–ELEVATION AND VOLUME–ELEVATION CURVES FOR SHANIR HAOR, 1993 (HALCROW SURVEY)

Elevation (m PWD)	Area ha	Volume m3
1.11	0.00	0
1.25	1.62	1,134
1.50	4.50	8,784
1.75	22.11	42,047
2.00	64.20	149,934
2.25	151.49	419,547
2.50	340.01	1,033,922
2.75	753.61	2,400,947
3.00	1,582.44	5,321,009
3.25	2,908.05	10,934,122
3.50	3,700.00	19,194,184
3.75	4,400.00	29,319,184
4.00	5,155.97	41,264,147
4.25	5,626.52	54,742,259
4.50	6,003.30	69,279,534
4.75	6,288.29	84,644,022
5.00	6,596.82	100,750,409
5.25	6,843.75	117,551,121
5.50	7,035.02	134,899,584
5.75	7,191.51	152,682,747
6.00	7,333.21	170,838,647
6.25	7,460.41	189,330,672
6.50	7,563.37	208,110,397
6.75	7,666.83	227,148,146
7.00	7,701.73	246,358,846
7.25	7,747.15	265,669,946
7.50	7,758.54	285,052,059
7.75	7,759.64	304,449,784
8.00	7,760.31	323,849,721
8.25	7,760.62	343,250,884
8.50	7,760.83	362,652,696
8.75	7,760.96	382,054,934
9.00	7,761.00	401,457,384

Table A3

INTERPOLATION EQUATIONS FOR SHANIHAOR (BASED ON SOB 1964)

ELEV (m PWD)	V (Ha)	A1	A Factor	AREA EQN
−0.25	0.00			
0.00	4.00	0	16.00	0.00+16.00*(H−−0.25)
0.25	20.00	4	64.00	4.00+64.00*(H−0.00)
0.50	40.00	20	80.00	20.00+80.00*(H−0.25)
0.75	60.00	40	160.00	40.00+160.00*(H−0.50)
1.00	200.00	80	480.00	80.00+480.00*(H−0.75)
1.25	300.00	200	400.00	200.00+400.00*(H−1.00)
1.50	500.00	300	800.00	300.00+800.00*(H−1.25)
1.75	850.00	500	1400.00	500.00+1400.00*(H−1.50)
2.00	1,325.00	850	1900.00	850.00+1900.00*(H−1.75)
2.25	1,800.00	1325	1900.00	1325.00+1900.00*(H−2.00)
2.50	2,362.50	1800	2350.24	1800.00+2350.24*(H−2.25)
2.75	2,931.35	2382.56	2195.16	2382.56+2195.16*(H−2.50)
3.00	3,391.69	2931.35	1841.36	2931.35+1841.36*(H−2.75)
3.25	5,801.45	3391.69	1639.04	3391.69+1639.04*(H−3.00)
3.50	4,190.45	3801.45	1556.00	3801.45+1556.00*(H−3.25)
3.75	4,636.42	4190.45	1791.88	4190.45+1791.88*(H−3.50)
4.00	5,155.97	4638.42	2070.20	4638.42+2070.20*(H−3.75)
4.25	5,626.52	5155.97	1682.20	5155.97+1682.20*(H−4.00)
4.50	6,003.30	5626.52	1507.12	5626.52+1507.12*(H−4.25)
4.75	6,268.29	6003.3	1139.96	6003.30+1139.96*(H−4.50)
5.00	6,596.82	6288.29	1234.12	6288.29+1234.12*(H−4.75)
5.25	6,843.75	6596.82	987.72	6596.82+987.72*(H−5.00)
5.50	7,035.02	6843.75	765.06	6843.75+765.06*(H−5.25)
5.75	7,191.51	7035.02	625.96	7035.02+625.96*(H−5.50)
6.00	7,333.21	7191.51	566.80	7191.51+566.80*(H−5.75)
6.25	7,460.41	7333.21	506.80	7333.21+506.80*(H−6.00)
6.50	7,563.37	7460.41	411.64	7460.41+411.64*(H−6.25)
6.75	7,666.83	7563.37	413.84	7563.37+413.84*(H−6.50)
7.00	7,701.73	7666.83	139.60	7666.83+139.60*(H−6.75)
7.25	7,747.15	7701.73	181.68	7701.73+181.68*(H−7.00)
7.50	7,758.54	7747.15	45.56	7747.15+45.56*(H−7.25)
7.75	7,759.64	7758.54	4.40	7758.54+4.40*(H−7.50)
8.00	7760.31	7759.64	2.68	7759.64+2.68*(H−7.75)
8.25	7760.62	7760.31	1.24	7760.31+1.24*(H−8.00)
8.50	7760.83	7760.62	0.84	7760.62+0.84*(H−8.25)
8.75	7760.96	7760.83	0.52	7760.83+0.52*(H−8.50)
9.00	7761.00	7760.96	0.16	7760.96+0.16*(H−8.75)

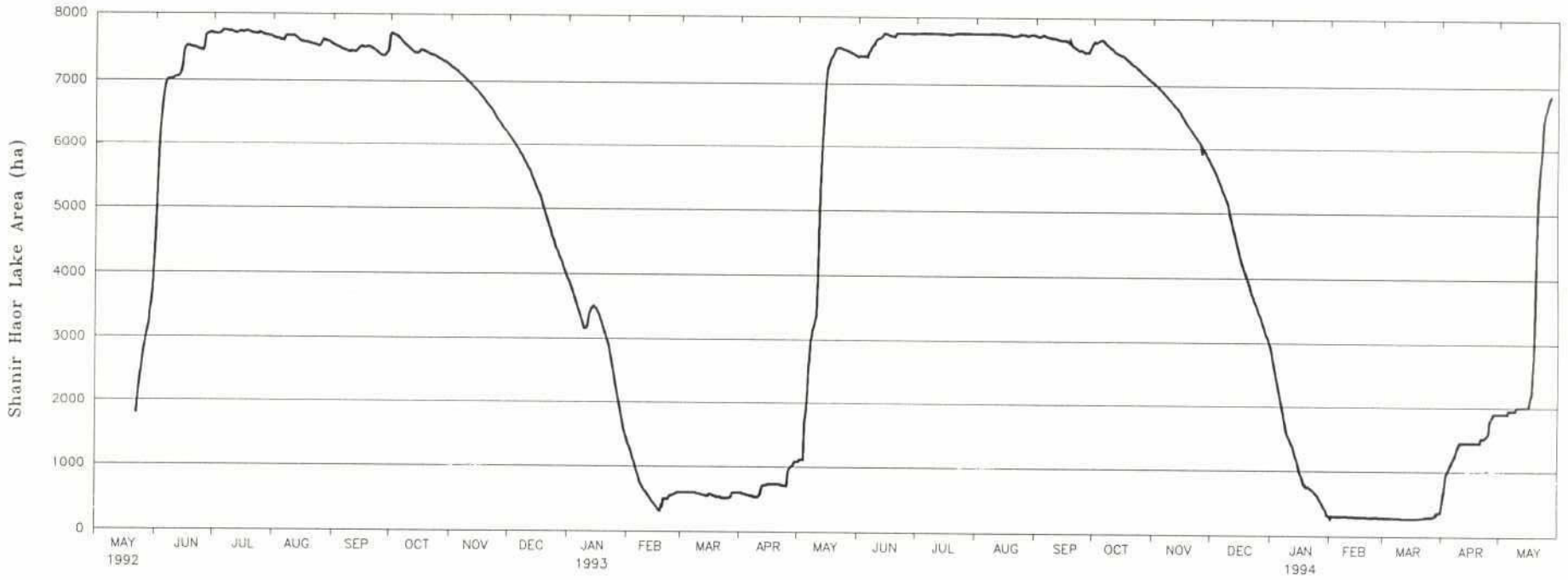
ELEV (m PWD)	S (m3)	S1	S FACTOR	S EQN
−0.25	0			
0.00	5,000	0	20000.00	0.00+20000.00*(H−−0.25)
0.25	35,000	5000	120000.00	5000.00+120000.00*(H−0.00)
0.50	110,000	35000	300000.00	35000.00+300000.00*(H−0.25)
0.75	260,000	110000	600000.00	110000.00+600000.00*(H−0.50)
1.00	610,000	260000	1400000.00	260000.00+1400000.00*(H−0.75)
1.25	1,235,000	610000	2500000.00	610000.00+2500000.00*(H−1.00)
1.50	2,235,000	1235000	4000000.00	1235000.00+4000000.00*(H−1.25)
1.75	3,922,500	2235000	6750000.00	2235000.00+6750000.00*(H−1.50)
2.00	9,641,250	3922500	10875000.00	3922500.00+10875000.00*(H−1.75)
2.25	10,547,500	6641250	15625000.00	6641250.00+15625000.00*(H−2.00)
2.50	15,775,700	10547500	20912800.00	10547500.00+20912800.00*(H−2.25)
2.75	22,416,988	15775700	26569550.00	15775700.00+26569550.00*(H−2.50)
3.00	30,321,888	22418987.5	31615200.00	22418987.50+31615200.00*(H−2.75)
3.25	39,313,313	30321887.5	35965700.00	30321887.50+35965700.00*(H−3.00)
3.50	49,303,188	39313312.5	39959500.00	39313312.50+39959500.00*(H−3.25)
3.75	60,339,275	49303187.5	44144350.00	49303187.50+44144350.00*(H−3.50)
4.00	72,582,263	60339275	48971950.00	60339275.00+48971950.00*(H−3.75)
4.25	86,060,375	72582262.5	53912450.00	72582262.50+53912450.00*(H−4.00)
4.50	100,567,650	86060375	58149100.00	86060375.00+58149100.00*(H−4.25)
4.75	115,962,138	100597650	61457950.00	100597650.00+61457950.00*(H−4.50)
5.00	132,068,525	115962137.5	64425550.00	115962137.50+64425550.00*(H−4.75)
5.25	148,869,238	132068525	67202850.00	132068525.00+67202850.00*(H−5.00)
5.50	166,217,700	148869237.5	69393850.00	148869237.50+69393850.00*(H−5.25)
5.75	184,000,863	166217700	71132650.00	166217700.00+71132650.00*(H−5.50)
6.00	202,156,763	184000862.5	72623600.00	184000862.50+72623600.00*(H−5.75)
6.25	220,646,788	202156762.5	73968100.00	202156762.50+73968100.00*(H−6.00)
6.50	239,426,513	220646787.5	75118900.00	220646787.50+75118900.00*(H−6.25)
6.75	258,466,263	239426512.5	76151000.00	239426512.50+76151000.00*(H−6.50)
7.00	277,676,963	258466262.5	76842600.00	258466262.50+76842600.00*(H−6.75)
7.25	296,968,062	277676962.5	77244400.00	277676962.50+77244400.00*(H−7.00)
7.50	316,370,175	296968062.5	77528450.00	296968062.50+77528450.00*(H−7.25)
7.75	335,767,900	316370175	77599900.00	316370175.00+77599900.00*(H−7.50)
8.00	355,167,837	335767900	77599750.00	335767900.00+77599750.00*(H−7.75)
8.25	374,569,000	355167837.5	77604650.00	355167837.50+77604650.00*(H−8.00)
8.50	393,970,812	374569000	77607250.00	374569000.00+77607250.00*(H−8.25)
8.75	413,373,050	393970812.5	77606950.00	393970812.50+77606950.00*(H−8.50)
9.00	432,775,500	413373050	77609600.00	413373050.00+77609600.00*(H−8.75)

Table A4

INTERPOLATION EQUATIONS FOR SHANIR HAOR (BASED ON HALCROW,1993)

ELEV (m PWD)	A (ha)	A1	A Factor	AREA EQN
1.11	0.00			
1.25	1.62	0	11.57	0.00+11.57*(H−1.11)
1.50	4.50	1.62	11.52	1.62+11.52*(H−1.25)
1.75	22.11	4.5	70.44	4.50+70.44*(H−1.50)
2.00	64.20	22.11	168.36	22.11+168.36*(H−1.75)
2.25	151.49	64.2	349.16	64.20+349.16*(H−2.00)
2.50	340.01	151.49	754.06	151.49+754.08*(H−2.25)
2.75	753.61	340.01	1654.40	340.01+1654.40*(H−2.50)
3.00	1,582.44	753.61	3315.32	753.61+3315.32*(H−2.75)
3.25	2,906.05	1582.44	5302.44	1582.44+5302.44*(H−3.00)
3.50	3,700.00	2906.05	3167.80	2906.05+3167.80*(H−3.25)
3.75	4,400.00	3700	2800.00	3700.00+2800.00*(H−3.50)
4.00	5,155.97	4400	3023.88	4400.00−3023.88*(H−3.75)
4.25	5,626.52	5155.97	1882.20	5155.97+1882.20*(H−4.00)
4.50	6,003.30	5626.52	1507.12	5626.52+1507.12*(H−4.25)
4.75	6,288.29	6003.3	1139.96	6003.30+1139.96*(H−4.50)
5.00	6,596.82	6288.29	1234.12	6288.29−1234.12*(H−4.75)
5.25	6,843.75	6596.82	987.72	6596.82+987.72*(H−5.00)
5.50	7,035.02	6843.75	765.08	6843.75+765.08*(H−5.25)
5.75	7,191.51	7035.02	625.96	7035.02+625.96*(H−5.50)
6.00	7,333.21	7191.51	566.80	7191.51+566.80*(H−5.75)
6.25	7,460.41	7333.21	508.80	7333.21+508.80*(H−6.00)
6.50	7,563.37	7460.41	411.84	7460.41+411.84*(H−6.25)
6.75	7,666.83	7563.37	413.84	7563.37+413.84*(H−6.50)
7.00	7,701.73	7666.83	139.60	7666.83+139.60*(H−6.75)
7.25	7,747.15	7701.73	181.68	7701.73+181.68*(H−7.00)
7.50	7,758.54	7747.15	45.56	7747.15+45.56*(H−7.25)
7.75	7,759.64	7758.54	4.40	7758.54+4.40*(H−7.50)
8.00	7,760.31	7759.64	2.68	7759.64+2.68*(H−7.75)
8.25	7,760.62	7760.31	1.24	7760.31+1.24*(H−8.00)
8.50	7,760.83	7760.62	0.84	7760.62+0.84*(H−8.25)
8.75	7,760.96	7760.83	0.52	7760.83+0.52*(H−8.50)
9.00	7,761.00	7760.96	0.16	7760.96+0.16*(H−8.75)

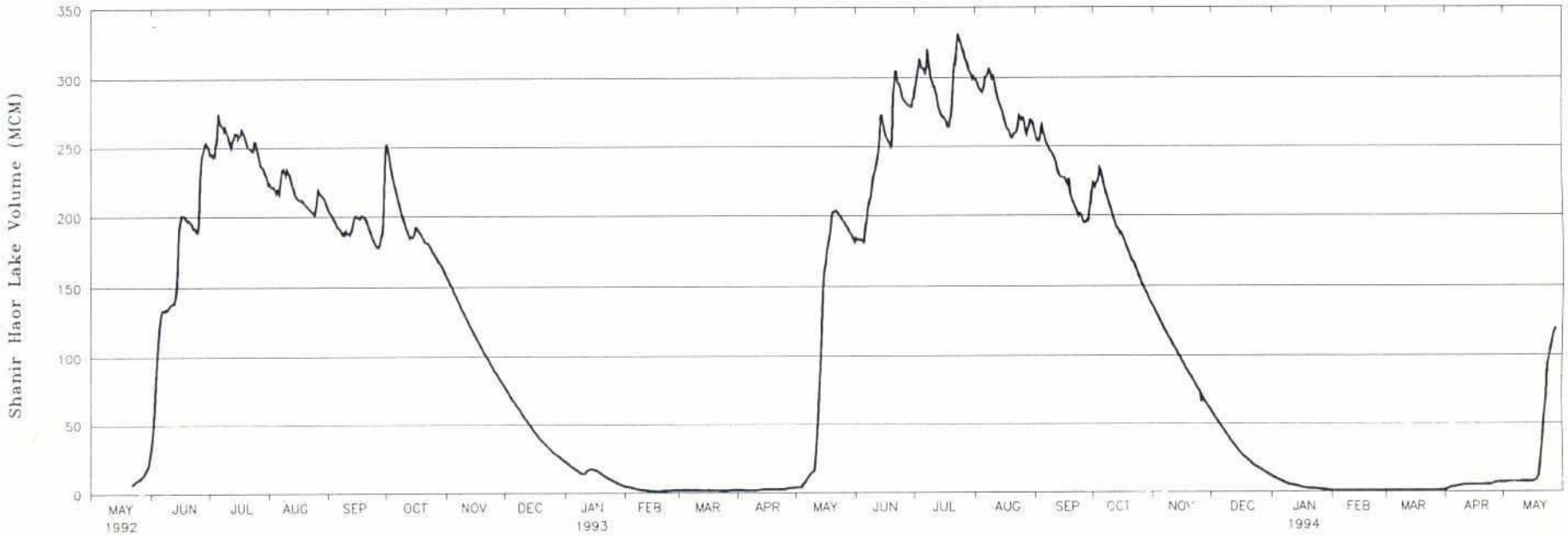
ELEV (m PWD)	S (m3)	S1	S FACTOR	S EQN
1.11	0			
1.25	1,134	0	8100.00	0.00+8100.00*(H−1.11)
1.50	6,784	1134	30600.00	1134.00+30600.00*(H−1.25)
1.75	42,047	8784	133050.00	8784.00+133050.00*(H−1.50)
2.00	149,934	42046.5	431550.00	42046.50+431550.00*(H−1.75)
2.25	419,547	149934	1078450.00	149934.00−1078450.00*(H−2.00)
2.50	1,033,922	419546.5	2457500.00	419546.50−2457500.00*(H−2.25)
2.75	2,400,947	1033921.5	5468100.00	1033921.50−5468100.00*(H−2.50)
3.00	5,321,009	2400946.5	11680250.00	2400946.50−11680250.00*(H−2.75)
3.25	10,934,122	5321009	22452450.00	5321009.00−22452450.00*(H−3.00)
3.50	19,194,184	10934121.5	33040250.00	10934121.50+33040250.00*(H−3.25)
3.75	29,319,184	19194184	40500000.00	19194184.00+40500000.00*(H−3.50)
4.00	41,264,147	29319184	47779850.00	29319184.00+47779650.00*(H−3.75)
4.25	54,742,259	41264146.5	53912450.00	41264146.50+53912450.00*(H−4.00)
4.50	69,279,534	54742259	58149100.00	54742259.00+58149100.00*(H−4.25)
4.75	84,644,022	69279534	61457950.00	69279534.00+61457950.00*(H−4.50)
5.00	100,750,409	84644021.5	64425550.00	84644021.50+64425550.00*(H−4.75)
5.25	117,551,121	100750409	67202850.00	100750409.00+67202850.00*(H−5.00)
5.50	134,899,584	117551121.5	69393650.00	117551121.50+69393650.00*(H−5.25)
5.75	152,682,747	134899584	71132650.00	134899584.00+71132650.00*(H−5.50)
6.00	170,838,647	152682746.5	72623600.00	152682746.50+72623600.00*(H−5.75)
6.25	189,330,672	170838646.5	73968100.00	170838646.50+73968100.00*(H−6.00)
6.50	208,110,397	189330671.5	75118900.00	189330671.50+75118900.00*(H−6.25)
6.75	227,148,146	208110396.5	76151000.00	208110396.50+76151000.00*(H−6.50)
7.00	246,358,846	227148146.5	76842800.00	227148146.50+76842800.00*(H−6.75)
7.25	265,669,946	246358846.5	77244400.00	246358846.50+77244400.00*(H−7.00)
7.50	285,052,059	265669946.5	77528450.00	265669946.50+77528450.00*(H−7.25)
7.75	304,449,784	285052059	77590900.00	285052059.00+77590900.00*(H−7.50)
8.00	323,849,721	304449784	77599750.00	304449784.00+77599750.00*(H−7.75)
8.25	343,250,884	323849721.5	77604650.00	323549721.50+77604650.00*(H−8.00)
8.50	362,652,696	343250884	77607250.00	343250884.00+77607250.00*(H−8.25)
8.75	382,054,934	362652696.5	77608950.00	362652696.50+77608950.00*(H−8.50)
9.00	401,457,384	382054934	77609800.00	382054934.00+77609800.00*(H−8.75)



Hydraulic Operation of Shanir Haor, 1992–94

Northeast Regional Project		
Shanir Haor Project Lake Area (ha), 1992–94		
Prepared by:	MEI/saa	June 1994
Drawn by:	Saa	AutoCAD Drawing

FILE: SAA-013.DWG



Hydraulic Operation of Shanir Haor, 1992–94

Northeast Regional Project	
Shanir Haor Project	
Lake Volume (MCM), 1992–94	
Prepared by: MEJ/saa	June 1994
Drawn by: Saa	AutoCAD Drawing

FILE: SAA-015.DWG

Project Monitoring Program

SHANIR HAOR FCD PROJECT

Baulai River Water Level (m PWD) at Marala (NERP Station)

1992

DAY	TIME	MAY G.R	MAY WL	JUNE G.R	JUNE WL	JULY G.R	JULY WL	AUGUST G.R	AUGUST WL	SEPT G.R	SEPT WL	OCTOBER G.R	OCTOBER WL	NOVEMBER G.R	NOVEMBER WL	DECEMBER G.R	DECEMBER WL
1	07:00			1.54	5.48	1.08	6.98	0.73	6.68	0.47	6.42	1.05	7.00	1.80	5.74	0.57	4.51
	06:00			1.53	5.47	1.01	6.96	0.72	6.67	0.46	6.41	1.00	6.95	1.78	5.72	0.55	4.49
2	07:00			1.51	5.45	1.03	6.99	0.73	6.66	0.44	6.39	0.93	6.88	1.75	5.68	0.53	4.47
	06:00			1.50	5.44	1.02	6.97	0.71	6.86	0.42	6.37	0.89	6.84	1.73	5.67	0.51	4.45
3	07:00			1.51	5.45	1.14	7.09	0.69	6.64	0.40	6.35	0.83	6.78	1.71	5.65	0.49	4.43
	06:00			1.51	5.45	1.14	7.09	0.67	6.62	0.39	8.34	0.80	6.75	1.69	5.63	0.48	4.42
4	07:00			1.51	5.45	1.30	7.25	0.70	6.65	0.37	6.32	0.75	6.70	1.67	5.61	0.45	4.38
	06:00			1.51	5.45	1.42	7.37	0.68	6.63	0.34	6.29	0.72	8.67	1.84	5.58	0.44	4.38
5	07:00			1.50	5.44	1.35	7.30	0.66	6.61	0.34	6.29	0.68	6.63	1.62	5.56	0.42	4.36
	06:00			1.50	5.44	1.33	7.28	0.75	6.70	0.33	6.28	0.64	6.59	1.60	5.54	0.40	4.34
6	07:00			1.49	5.43	1.30	7.25	0.84	6.79	0.32	6.27	0.60	6.55	1.58	5.52	0.38	4.32
	06:00			1.50	5.44	1.30	7.25	0.89	6.84	0.30	6.25	0.57	6.52	1.56	5.50	0.36	4.30
7	07:00			1.49	5.43	1.28	7.23	0.90	6.85	0.29	6.23	0.53	8.48	1.54	5.48	0.34	4.28
	06:00			1.51	5.45	1.24	7.19	0.87	6.82	0.27	6.22	0.50	6.45	1.52	5.46	0.32	4.26
8	07:00			1.51	5.45	1.29	7.23	0.86	6.81	0.29	6.24	0.46	6.41	1.49	5.43	0.30	4.24
	06:00			1.52	5.46	1.25	7.20	0.84	6.79	0.27	6.22	0.44	6.39	1.47	5.41	0.28	4.22
9	07:00			1.53	5.47	1.23	7.19	0.89	6.84	0.30	6.25	0.40	6.36	1.45	5.39	0.26	4.20
	06:00			1.55	5.49	1.21	7.16	0.87	6.62	0.29	6.23	0.38	6.33	1.43	5.37	0.24	4.18
10	07:00			1.55	5.49	1.14	7.09	0.86	6.81	0.28	6.23	0.34	6.29	1.41	5.35	0.22	4.16
	06:00			1.56	5.50	1.13	7.08	0.84	6.79	0.28	6.28	0.32	6.27	1.39	5.33	0.20	4.14
11	07:00			1.57	5.51	1.10	7.05	0.80	6.75	0.27	6.22	0.29	6.24	1.36	5.30	0.18	4.12
	06:00			1.57	5.51	1.13	7.08	0.76	6.71	0.29	6.24	0.27	6.22	1.34	5.28	0.16	4.10
12	07:00			1.60	5.54	1.18	7.13	0.73	6.68	0.31	6.28	0.24	6.19	1.33	5.27	0.14	4.08
	06:00			1.67	5.61	1.18	7.13	0.71	6.66	0.36	6.31	0.25	6.20	1.31	5.25	0.12	4.06
13	07:00			1.78	5.72	1.23	7.18	0.66	6.61	0.41	6.36	0.24	6.18	1.29	5.23	0.10	4.04
	06:00			1.96	5.90	1.23	7.18	0.64	6.59	0.43	6.38	0.24	6.19	1.28	5.22	0.08	4.02
14	07:00			0.30	6.25	1.23	7.18	0.63	6.58	0.45	6.40	0.25	6.20	1.26	5.20	0.06	4.00
	06:00			0.36	6.31	1.16	7.13	0.61	6.56	0.45	6.40	0.27	6.22	1.23	5.17	0.04	3.98
15	07:00		3.84	0.42	6.37	1.20	7.15	0.61	6.56	0.43	6.38	0.34	6.29	1.21	5.15	0.01	3.96
	06:00		3.96	0.45	6.40	1.21	7.16	0.60	6.55	0.43	6.38	0.34	6.29	1.19	5.13	1.89	3.94
16	07:00		4.14	0.45	6.40	1.22	7.17	0.60	6.56	0.42	6.37	0.32	8.27	1.17	5.11	1.96	3.91
	06:00		4.26	0.45	6.40	1.28	7.28	0.59	6.54	0.42	6.37	0.31	6.26	1.15	5.09	1.95	3.90
17	07:00		4.43	0.44	6.39	1.25	7.20	0.60	6.55	0.45	6.40	0.29	6.24	1.12	5.06	1.94	[illegible]
	06:00		4.56	0.42	6.37	1.23	7.16	0.59	6.54	0.45	6.40	0.28	6.23	1.10	5.04	1.62	3.87
18	07:00	0.79	4.73	0.41	6.36	1.20	7.15	0.57	6.52	0.44	6.39	0.27	6.22	1.08	5.02	1.88	3.64
	06:00	1.24	5.18	0.40	6.35	1.16	7.11	0.55	6.51	0.44	6.39	0.25	6.20	1.07	5.01	1.89	3.83
19	07:00	1.27	5.21	0.41	6.36	1.13	7.09	0.55	6.50	0.42	6.37	0.28	6.18	1.04	4.98	1.96	3.81
	06:00	1.28	5.22	0.40	6.35	1.10	7.05	0.54	6.49	0.41	8.36	0.22	6.17	1.02	4.96	1.84	3.79
20	07:00	1.31	5.25	0.38	6.33	1.09	7.04	0.53	6.48	0.38	6.33	0.20	6.15	1.00	4.94	1.62	3.77
	06:00	1.32	5.26	0.38	6.33	1.08	7.04	0.52	6.47	0.36	6.31	0.19	6.14	0.99	4.93	1.90	3.75
21	07:00	1.34	5.28	0.36	6.31	1.08	7.03	0.51	6.46	0.33	6.28	0.19	6.14	0.96	4.90	1.77	3.72
	06:00	1.30	5.24	0.33	6.28	1.07	7.02	0.50	6.45	0.31	6.26	0.18	6.14	0.95	4.89	1.76	3.71
22	07:00	1.28	5.22	0.33	6.28	1.06	7.01	0.49	6.44	0.28	6.28	0.17	6.12	0.93	4.87	1.74	3.69
	06:00	1.27	5.21	0.32	6.27	1.06	7.01	0.48	6.43	0.28	8.21	0.16	6.11	0.90	4.84	1.72	3.67
23	07:00	1.29	5.23	0.30	6.25	1.15	7.10	0.47	6.42	0.28	6.16	0.14	6.09	0.68	4.62	1.70	3.65
	06:00	1.28	5.22	0.29	6.24	1.15	7.10	0.46	6.41	0.21	6.16	0.12	6.07	0.87	4.81	1.89	3.64
24	07:00	1.31	5.25	0.30	6.25	1.11	7.06	0.50	6.45	0.19	6.14	0.10	6.05	0.84	4.79	1.67	3.62
	06:00	1.31	5.25	0.40	6.35	1.07	7.02	0.55	6.50	0.17	6.12	0.09	6.04	0.83	4.77	1.65	3.60
25	07:00	1.31	5.25	0.79	6.74	1.02	6.97	0.67	6.62	0.16	6.11	0.07	6.02	0.81	4.75	1.64	3.59
	06:00	1.32	5.26	0.93	6.88	0.99	6.94	0.70	6.65	0.15	6.10	0.08	6.01	0.79	4.73	1.62	3.57
26	07:00	1.36	5.30	1.03	6.98	0.94	6.88	0.68	6.63	0.15	6.10	0.04	5.99	0.77	4.71	1.60	3.56
	06:00	1.39	5.33	1.05	7.00	0.92	6.87	0.66	6.61	0.16	6.11	0.02	5.97	0.75	4.69	1.58	3.53
27	07:00	1.42	5.36	1.10	7.05	0.92	6.87	0.65	6.60	0.21	6.16	0.00	5.95	0.73	4.67	1.56	3.51
	06:00	1.44	5.38	1.13	7.08	0.81	6.86	0.64	6.59	0.25	6.20	1.98	5.92	0.71	4.65	1.56	3.50
28	07:00	1.50	5.44	1.14	7.09	0.89	6.84	0.63	6.59	0.28	6.23	1.96	5.90	0.69	4.63	1.53	3.48
	06:00	1.52	5.46	1.11	7.06	0.86	6.81	0.62	6.57	0.38	6.33	1.95	5.89	0.68	4.62	1.52	3.47
29	07:00	1.56	5.50	1.11	7.06	0.84	6.79	0.59	6.54	0.85	6.80	1.93	5.67	0.65	4.59	1.49	3.44
	06:00	1.56	5.50	1.07	7.02	0.83	6.78	0.57	6.52	1.05	7.00	1.91	5.85	0.63	4.57	1.48	3.43
30	07:00	1.57	5.51	1.03	6.98	0.79	6.74	0.54	6.49	1.13	7.08	1.88	5.82	0.61	4.55	1.46	3.41
	06:00	1.56	5.50	1.04	6.99	0.75	6.70	0.52	6.47	1.11	7.06	1.87	5.81	0.60	4.54	1.45	3.40
31	07:00	1.56	5.50			0.76	6.71	0.50	6.45			1.84	5.78			1.43	3.38
	06:00	1.56	5.50			0.74	6.69	0.48	6.43			1.82	5.76			1.41	3.36

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DAY	TIME	JANUARY G.R	JANUARY WL	FEBRUARY G.R	FEBRUARY WL	MARCH G.R	MARCH WL	APRIL G.R	APRIL WL	MAY G.R	MAY WL	JUNE G.R	JUNE WL	JULY G.R	JULY WL	AUGUST G.R	AUGUST WL	SEPT G.R	SEPT WL	OCTOBER G.R	OCTOBER WL	NOVEMBER G.R	NOVEMBER WL	DECEMBER G.R	DECEMBER WL
1	07:00	1.38	3.33	0.83	2.78	0.58	4.52	0.24	4.18	0.25	4.18	0.22	6.17	1.74	7.69	1.69	7.64	1.15	7.10	0.72	6.67	1.49	5.43	0.31	4.25
	06:00	1.37	3.32	0.82	2.77	0.53	4.47	0.20	4.14	0.30	4.24	0.21	6.16	1.79	7.74	1.65	7.60	1.15	7.10	0.75	6.70	1.47	5.41	0.28	4.22
2	07:00	1.35	3.30	0.90	2.75	0.47	4.41	0.14	4.08	0.34	4.28	0.22	6.17	1.85	7.80	1.64	7.58	1.15	7.10	0.77	6.72	1.45	5.39	0.26	4.20
	06:00	1.34	3.29	0.79	2.74	0.44	4.38	0.08	4.03	0.36	4.30	0.21	6.16	1.92	7.87	1.62	7.57	1.19	7.14	0.77	6.72	1.43	5.37	0.24	4.19
3	07:00	1.32	3.27	0.77	2.72	0.38	4.33	0.01	3.95	0.38	4.32	0.21	6.16	1.88	7.83	1.62	7.57	1.28	7.23	0.84	6.79	1.41	5.35	0.22	4.16
	06:00	1.31	3.26	0.76	2.71	0.35	4.29	1.95	3.90	0.50	4.44	0.20	6.15	1.83	7.79	1.61	7.56	1.30	7.25	0.90	6.85	1.39	5.33	0.20	4.14
4	07:00	1.28	3.23	0.74	2.69	0.30	4.24	1.87	3.82	0.74	4.68	0.19	6.14	1.63	7.78	1.64	7.59	1.24	7.19	0.88	6.83	1.37	5.31	0.18	4.12
	06:00	1.27	3.22	0.73	2.68	0.25	4.19	1.81	3.76	0.81	4.95	0.30	6.25	1.83	7.78	1.67	7.62	1.21	7.16	0.84	6.79	1.35	5.29	0.16	4.10
5	07:00	1.26	3.21	0.71	2.66	0.16	4.12	1.72	3.67	1.16	5.10	0.37	6.32	1.79	7.74	1.75	7.70	1.17	7.12	0.79	6.74	1.33	5.27	0.14	4.08
	06:00	1.25	3.20	0.69	2.64	0.13	4.07	1.86	3.81	1.31	5.25	0.39	6.34	1.78	7.73	1.75	7.70	1.13	7.08	0.75	6.70	1.32	5.26	0.12	4.06
6	07:00	1.23	3.16	0.67	2.62	0.07	4.01	1.59	3.53	1.39	5.33	0.52	6.47	1.87	7.82	1.77	7.72	1.12	7.07	0.70	6.65	1.30	5.24	0.10	4.04
	06:00	1.22	3.17	0.66	2.61	0.01	3.95	1.52	3.47	1.33	5.27	0.55	6.50	2.01	7.96	1.78	7.74	1.10	7.05	0.67	6.62	1.28	5.22	0.08	4.02
7	07:00	1.21	3.16	0.64	2.59	1.95	3.90	1.45	3.40	1.37	5.31	0.60	6.55	1.91	7.86	1.62	7.77	1.07	7.02	0.64	6.59	1.26	5.20	0.06	4.00
	06:00	1.20	3.15	0.63	2.58	1.91	3.86	1.40	3.35	1.41	5.35	0.61	6.58	1.65	7.80	1.81	7.76	1.06	7.01	0.62	6.57	1.24	5.18	0.04	3.98
8	07:00	1.19	3.14	0.61	2.58	1.85	3.60	1.33	3.28	1.51	5.45	0.70	6.65	1.77	7.72	1.77	7.72	1.05	7.00	0.57	6.52	1.22	5.16	0.02	3.90
	06:00	1.16	3.13	0.60	2.56	1.81	3.76	1.30	3.25	1.55	5.49	0.78	6.73	1.72	7.67	1.72	7.67	1.04	6.89	0.55	8.50	1.20	5.14	1.99	3.94
9	07:00	1.24	3.19	0.58	2.53	1.75	3.70	1.24	3.19	1.58	5.52	0.84	6.79	1.71	7.66	1.77	7.72	1.02	6.97	0.52	6.47	1.18	5.12	1.87	3.92
	06:00	1.29	3.24	0.57	2.52	1.71	3.66	1.21	3.16	1.60	5.54	0.86	6.81	1.68	7.61	1.73	7.68	1.01	6.96	0.50	6.45	1.16	5.10	1.95	3.90
10	07:00	1.39	3.34	0.56	2.51	1.66	3.61	1.16	3.11	1.58	5.52	0.90	6.85	1.66	7.61	1.69	7.64	0.98	6.93	0.45	6.40	1.14	5.08	1.83	3.88
	06:00	1.44	3.39	0.56	2.51	1.62	3.57	1.15	3.10	1.57	5.51	0.85	6.90	1.63	7.58	1.63	7.58	0.96	6.91	0.43	6.38	1.12	5.06	1.91	3.86
11	07:00	1.46	3.41	0.55	2.50	1.57	3.52	1.34	3.29	1.56	5.50	1.00	6.95	1.58	7.54	1.59	7.54	0.91	6.86	0.39	6.34	1.10	5.04	1.88	3.84
	06:00	1.45	3.40	0.54	2.49	1.54	3.49	1.45	3.40	1.54	5.48	1.05	7.00	1.54	7.49	1.55	7.50	0.88	6.83	0.38	6.33	1.08	5.02	1.87	3.82
12	07:00	1.45	3.40	0.53	2.48	1.49	3.44	1.55	3.51	1.60	5.54	1.17	7.12	1.47	7.42	1.52	7.47	0.95	6.80	0.34	6.28	1.06	5.00	1.95	3.80
	06:00	1.44	3.39	0.52	2.47	1.46	3.41	1.61	3.56	1.63	5.57	1.37	7.32	1.46	7.41	1.50	7.45	0.83	6.78	0.32	6.27	1.04	4.98	1.83	3.78
13	07:00	1.44	3.39	0.50	2.45	1.40	3.35	1.63	3.58	1.71	5.65	1.40	7.35	1.42	7.37	1.47	7.42	0.82	6.77	0.32	6.27	1.02	4.98	1.81	3.76
	06:00	1.43	3.38	0.49	2.44	1.37	3.32	1.63	3.58	1.71	5.85	1.35	7.30	1.39	7.34	1.45	7.40	0.81	6.76	0.30	6.25	1.00	4.94	1.79	3.74
14	07:00	1.41	3.36	0.48	2.43	1.32	3.27	1.68	3.56	1.80	5.74	1.30	7.25	1.39	7.34	1.42	7.37	0.81	6.76	0.27	8.22	0.88	4.92	1.77	3.72
	06:00	1.40	3.35	0.48	2.43	1.29	3.24	1.62	3.57	1.88	5.82	1.26	7.21	1.37	7.32	1.38	7.33	0.81	6.76	0.28	6.23	0.96	4.90	1.76	3.71
15	07:00	1.38	3.33	0.50	2.45	1.25	3.20	1.61	3.56	1.84	6.68	1.21	7.16	1.37	7.32	1.34	7.28	0.81	6.76	0.28	6.21	0.95	4.89	1.74	3.69
	06:00	1.37	3.32	0.50	2.45	1.28	3.21	1.59	3.54	1.98	5.92	1.19	7.14	1.35	7.30	1.31	7.26	0.80	6.75	0.25	6.20	0.93	4.87	1.73	3.68
16	07:00	1.35	3.30	0.51	2.46	1.25	3.20	1.57	3.52	0.12	6.07	1.17	7.12	1.34	7.29	1.28	7.23	0.76	8.71	0.22	6.17	0.91	4.85	1.71	3.66
	06:00	1.34	3.29	0.51	2.46	1.24	3.18	1.55	3.50	0.15	6.10	1.15	7.10	1.29	7.24	1.26	7.21	0.76	6.71	0.20	6.15	0.88	4.83	1.70	3.65
17	07:00	1.32	3.27	0.50	2.45	1.24	[illegible]	[illegible]	3.46	0.21	6.16	1.13	7.08	1.28	7.23	1.26	7.21	0.72	6.67	0.17	8.12	0.97	4.91	1.88	3.63
	06:00	1.30	3.25	0.50	2.45	1.24	[illegible]	[illegible]	3.45	0.25	6.20	1.12	7.07	1.28	7.23	1.24	7.19	0.80	8.75	0.15	6.10	0.85	4.79	1.86	3.61
18	07:00	1.28	3.23	0.61	2.56	1.24	3.19	1.47	3.42	0.33	6.28	1.08	7.03	1.36	7.31	1.20	7.15	0.68	6.61	0.12	6.07	0.82	4.76	1.64	3.59
	06:00	1.27	3.22	0.99	2.84	1.28	3.19	1.45	3.40	0.44	6.39	1.17	7.12	1.39	7.33	1.18	7.13	0.63	6.58	0.10	6.05	0.81	4.75	1.68	3.58
19	07:00	1.24	3.18	1.53	3.48	1.21	3.16	1.42	3.37	0.48	6.43	1.60	7.55	1.51	7.46	1.16	7.13	0.59	8.54	0.07	6.02	0.78	4.73	1.61	3.56
	06:00	1.23	3.18	1.88	3.83	1.16	3.13	1.39	3.34	0.48	6.43	1.85	7.80	1.96	7.61	1.20	7.15	0.57	6.52	0.05	6.00	0.77	4.71	1.60	3.55
20	07:00	1.20	3.15	0.22	4.15	1.15	3.10	[illegible]	[illegible]	0.48	6.43	1.90	7.75	1.96	7.61	1.22	7.17	0.55	6.50	0.02	5.97	0.75	4.69	1.58	3.53
	06:00	1.19	3.14	0.37	4.31	1.13	3.08	[illegible]	[illegible]	0.49	6.44	1.80	7.75	1.96	7.61	1.22	7.17	0.53	6.48	0.00	5.95	0.73	4.67	1.56	3.51
21	07:00	1.17	3.12	0.54	4.48	1.09	3.04	1.28	3.23	0.48	6.43	1.73	7.68	1.94	7.89	1.23	7.16	0.51	6.46	1.97	5.91	0.71	4.65	1.53	3.48
	06:00	1.15	3.10	0.64	4.58	1.08	3.01	1.25	3.20	0.48	6.43	1.69	7.64	2.06	6.01	1.26	7.21	0.49	6.44	1.95	5.89	0.69	4.63	1.52	3.47
22	07:00	1.13	3.08	0.75	4.69	1.04	2.98	1.21	3.16	0.46	6.41	1.88	7.64	2.15	6.10	1.32	7.27	0.44	6.38	1.92	5.86	0.67	4.61	1.50	3.45
	06:00	1.12	3.07	0.77	4.71	1.04	2.98	1.18	3.13	0.45	6.40	1.66	7.61	2.11	6.06	1.38	7.34	0.43	6.39	1.90	5.84	0.65	4.59	1.49	3.44
23	07:00	1.10	3.05	0.81	4.75	1.06	3.01	1.16	3.11	0.43	6.38	1.62	7.57	2.09	8.04	1.38	7.33	0.46	6.41	1.87	5.81	0.63	4.57	1.47	3.42
	06:00	1.09	3.04	0.86	4.80	1.10	3.05	1.16	3.11	0.42	6.37	1.59	7.53	2.07	6.02	1.35	7.30	0.46	6.41	1.85	5.79	0.61	4.55	1.45	3.40
24	07:00	1.08	3.03	0.91	4.85	1.15	3.10	1.15	3.10	0.40	6.35	1.55	7.50	2.03	7.98	1.35	7.30	0.43	8.38	1.82	5.76	0.59	4.53	1.43	3.38
	06:00	1.08	3.01	0.92	4.86	1.28	3.21	1.14	3.09	0.39	6.34	1.53	7.48	2.00	7.95	1.38	7.33	0.41	8.36	1.80	5.74	0.47	4.41	1.42	3.37
25	07:00	1.04	2.99	0.92	4.86	1.39	3.34	1.25	3.20	0.38	6.33	1.52	7.47	1.97	7.92	1.34	7.29	0.38	6.33	1.77	5.71	0.55	4.49	1.40	3.35
	06:00	1.03	2.98	0.81	4.85	1.58	3.53	1.31	3.26	0.36	6.31	1.51	7.46	1.93	7.88	1.28	7.23	0.37	6.32	1.76	5.70	0.53	4.47	1.38	3.33
26	07:00	1.01	2.96	0.87	4.61	1.61	3.78	1.41	3.36	0.34	6.29	1.50	7.45	1.91	7.86	1.23	7.16	0.38	6.33	1.73	5.67	0.51	4.45	1.35	3.30
	06:00	1.00	2.95	0.84	4.79	1.94	3.69	1.46	3.41	0.33	6.28	1.49	7.44	1.89	7.84	1.21	7.16	0.38	6.33	1.71	5.85	0.49	4.43	1.34	3.29
27	07:00	0.98	2.93	0.78	4.72	0.16	4.10	1.54	3.49	0.31	6.26	1.48	7.43	1.86	7.81	1.26	7.21	0.40	6.35	1.69	5.63	0.47	4.41	1.33	3.28
	06:00	0.97	2.92	0.78	4.70	0.27	4.21	1.60	3.55	0.30	6.25	1.48	7.43	1.82	7.77	1.28	7.23	0.38	6.33	1.67	5.61	0.45	4.39	1.31	3.26
28	07:00	0.95	2.90	0.88	4.62	0.39	4.33	1.69	3.64	0.28	6.23	1.47	7.42	1.80	7.75	1.35	7.30	0.52	6.47	1.64	5.58	0.43	4.37	1.28	3.23
	06:00	0.94	2.89	0.85	4.59	0.45	4.39	1.74	3.69	0.27	6.22	1.47	7.42	1.78	7.73	1.35	7.30	0.54	6.49	1.63	5.57	0.41	4.35	1.27	3.22
29	07:00	0.92	2.87			0.48	4.42	1.81	3.76	0.24	6.19	1.56	7.51	1.75	7.70	1.34	7.29	0.66	6.61	1.60	5.54	0.39	4.32	1.26	3.21
	06:00	0.91	2.86			0.49	4.43	1.86	3.88	0.23	6.18	1.54	7.48	1.73	7.68	1.33	7.28	0.71	6.66	1.58	5.52	0.36	4.30	1.26	3.21
30	07:00	0.89	2.84			0.45	4.39	0.06	4.00	0.20	6.15	1.64	7.58	1.75	7.70	1.28	7.23	0.76	6.71	1.57	5.51	0.34	4.28	1.24	3.19
	06:00	0.88	2.83			0.41	4.35	0.16	4.10	0.19	6.14	1.67	7.82	1.73	7.68	1.25	7.20	0.75	6.70	1.55	5.49	0.33	4.27	1.23	3.18
31	07:00	0.96	2.91			0.36	4.30			0.23	6.16			1.73	7.68	1.20	7.15			1.53	5.47			1.21	3.16
	06:00	0.85	2.80			0.31	4.25			0.22	6.17			1.71	7.66	1.17	7.12			1.51	5.45			1.20	3.15

1994

DAY	TIME	JANUARY G.R	JANUARY WL	FEBRUARY G.R	FEBRUARY WL	MARCH G.R	MARCH WL	APRIL G.R	APRIL WL	MAY G.R	MAY WL
1	07:00	1.17	3.12	0.43	2.38	0.10	2.05	1.54	5.48	1.03	4.97
	06:00	1.16	3.11	0.43	2.38	0.10	2.05	1.57	5.51	1.00	4.94
2	07:00	1.14	3.09	0.43	2.38	0.12	2.07	1.57	5.51	0.97	4.91
	06:00	1.13	3.08	0.44	2.38	0.13	2.08	1.59	5.53	0.93	4.67
3	07:00	1.12	3.07	0.44	2.39	0.11	2.06	1.62	5.56	0.90	4.84
	06:00	1.10	3.05	0.44	2.39	0.10	2.05	1.61	5.55	0.86	4.80
4	07:00	1.07	3.02	0.44	2.39	0.08	2.03	1.67	5.61	0.80	4.74
	06:00	1.06	3.01	0.44	2.38	0.06	2.01	1.70	5.64	0.77	4.71
5	07:00	1.05	3.00	0.46	2.41	0.02	1.87	1.68	5.62	0.77	4.71
	06:00	1.03	2.98	0.45	2.40	0.89	1.83	1.86	5.80	0.75	4.69
6	07:00	1.01	2.96	0.44	2.38	0.96	1.90	1.66	5.80	0.73	4.87
	06:00	1.00	2.95	0.41	2.36	0.94	1.89	1.67	5.61	0.73	4.87
7	07:00	0.97	2.92	0.38	2.33	0.92	1.88	1.71	5.85	0.77	4.71
	06:00	0.96	2.91	0.35	2.30	0.81	1.85	1.74	5.66	0.81	4.75
8	07:00	0.95	2.90	0.32	2.27	0.90	1.84	1.72	5.66	0.87	4.61
	06:00	0.93	2.88	0.30	2.25	0.68	1.82	1.84	5.58	0.92	4.96
9	07:00	0.92	2.87	0.27	2.22	0.87	1.81	1.55	5.48	1.00	4.94
	06:00	0.91	2.86	0.26	2.21	0.86	1.80	1.54	5.48	1.04	4.96
10	07:00	0.89	2.84	0.27	2.22	0.64	1.79	1.51	5.45	1.08	5.02
	06:00	0.88	2.83	0.26	2.21	0.63	1.77	1.50	5.44	1.11	5.05
11	07:00	0.87	2.82	0.27	2.22	0.92	1.76	1.49	5.43	1.13	5.07
	06:00	0.86	2.81	0.28	2.23	0.62	1.76	1.48	5.42	1.15	5.09
12	07:00	0.64	2.79	0.30	2.25	0.82	1.76	1.48	5.42	1.16	5.10
	06:00	0.83	2.76	0.30	2.25	0.62	1.76	1.48	5.42	1.17	5.11
13	07:00	0.81	2.76	0.31	2.26	0.84	1.78	1.48	5.42	1.18	5.12
	06:00	0.80	2.75	0.30	2.25	0.86	1.80	1.47	5.41	1.17	5.11
14	07:00	0.78	2.73	0.28	2.23	0.88	1.82	1.45	5.39	1.18	5.12
	06:00	0.77	2.72	0.27	2.22	0.91	1.85	1.43	5.37	1.17	5.11
15	07:00	0.75	2.70	0.24	2.19	0.94	1.88	1.40	5.34	1.16	5.12
	06:00	0.74	2.69	0.22	2.17	0.99	1.93	1.37	5.31	1.18	5.12
16	07:00	0.73	2.69	0.20	2.15	0.02	1.97	1.33	5.27	1.16	5.12
	06:00	0.73	2.68	0.18	2.13	0.05	2.00	1.30	5.24	1.17	5.11
17	07:00	0.71	2.66	0.16	2.11	0.12	2.07	1.25	5.19	1.17	5.11
	06:00	0.72	2.67	0.14	2.09	0.23	2.19	1.22	5.16	1.20	5.14
18	07:00	0.75	2.70	0.12	2.07	0.32	2.27	1.16	5.12	1.19	5.13
	06:00	0.76	2.71	0.11	2.06	0.34	2.29	1.17	5.11	1.17	5.11
19	07:00	0.77	2.72	0.09	2.04	0.33	2.28	1.15	5.09	1.16	5.10
	06:00	0.76	2.71	0.07	2.02	0.33	2.28	1.16	6.10	1.15	5.09
20	07:00	0.73	2.68	0.05	2.00	0.38	2.33	1.16	5.10	1.13	5.07
	06:00	0.70	2.65	0.02	1.87	0.52	2.47	1.18	5.12	1.12	5.06
21	07:00	0.67	2.62	0.99	1.93	0.75	2.70	1.18	5.12	1.09	5.03
	06:00	0.85	2.60	0.97	1.91	0.93	2.88	1.19	5.12	1.06	5.00
22	07:00	0.63	2.58	0.95	1.88	1.26	3.21	1.19	5.12	1.02	4.96
	06:00	0.61	2.56	0.98	1.90	1.56	3.51	1.17	5.11	1.00	4.94
23	07:00	0.59	2.54	0.96	1.90	0.01	3.95	1.16	5.10	1.14	5.08
	06:00	0.58	2.51	0.98	1.92	0.29	4.28	1.16	5.10	1.14	5.08
24	07:00	0.55	2.50	0.01	1.96	0.61	4.55	1.17	5.11	1.15	5.09
	06:00	0.52	2.47	0.03	1.98	0.73	4.67	1.17	5.11	1.15	5.09
25	07:00	0.50	2.45	0.07	2.02	0.85	4.79	1.21	5.15	1.16	5.12
	06:00	0.49	2.44	0.10	2.05	0.90	4.84	1.21	6.15	1.22	5.16
26	07:00	0.47	2.42	0.11	2.06	0.85	4.99	1.24	5.16	1.27	5.21
	06:00	0.46	2.41	0.11	2.06	0.90	4.84	1.23	5.17	1.29	5.23
27	07:00	0.45	2.40	0.10	2.05	1.07	5.01	1.21	5.15	1.32	5.26
	06:00	0.44	2.38	0.10	2.05	1.16	5.12	1.18	5.12		
28	07:00	0.43	2.38	0.08	2.06	1.32	5.26	1.14	5.08		
	06:00	0.42	2.37	0.09	2.04	1.46	5.40	1.13	6.07		
29	07:00	0.42	2.37			1.50	5.44	1.11	5.05		
	06:00	0.42	2.37			1.52	5.46	1.10	5.04		
30	07:00	0.41	2.36			1.51	5.45	1.08	5.02		
	06:00	0.41	2.36			1.51	5.45	1.08	5.00		
31	07:00	0.41	2.36			1.53	5.47				
	06:00	0.42	2.37			1.52	5.46				

ZERO VALUES: 5.954m C; 3.941m R1; 1.947m R2

Project Monitoring Program

SHANIR HAOR FCD PROJECT

Shanir Haor Water Level (m PWD) at Marala (NERP Station)

1992

DAY	TIME	MAY G.R	MAY WL	JUNE G.R	JUNE WL	JULY G.R	JULY WL	AUGUST G.R	AUGUST WL	SEPT G.R	SEPT WL	OCTOBER G.R	OCTOBER WL	NOVEMBER G.R	NOVEMBER WL	DECEMBER G.R	DECEMBER WL
1	07:05			0.23	4.20	1.08	6.98	0.73	6.68	0.47	8.42	1.05	7.00	1.81	5.78	0.62	4.59
	06:05			0.43	4.40	1.01	6.96	0.72	6.67	0.46	6.41	1.00	6.95	1.79	5.78	0.60	4.57
2	07:05			0.68	4.66	1.08	6.98	0.73	6.68	0.44	6.39	0.93	6.99	1.76	5.73	0.58	4.55
	06:05			0.84	4.81	1.02	6.97	0.71	6.66	0.42	6.37	0.89	6.84	1.75	5.72	0.56	4.53
3	07:05			1.04	5.01	1.14	7.09	0.68	6.64	0.40	6.35	0.83	6.78	1.73	5.70	0.54	4.51
	05:05			1.16	5.13	1.14	7.09	0.67	6.62	0.38	6.34	0.80	6.75	1.70	5.67	0.52	4.49
4	07:05			1.30	5.27	1.30	7.25	0.70	8.65	0.37	6.32	0.75	6.70	1.68	5.65	0.50	4.47
	06:05			1.39	5.36	1.42	7.37	0.68	6.63	0.34	6.28	0.72	6.67	1.66	5.63	0.49	4.46
5	07:05			1.47	5.44	1.35	7.30	0.66	6.61	0.34	6.29	0.68	6.63	1.64	5.61	0.47	4.44
	06:05			1.50	5.47	1.33	7.28	0.75	6.70	0.33	6.28	0.64	6.59	1.62	5.58	0.45	4.42
6	07:05			1.51	5.48	1.30	7.25	0.84	6.79	0.32	8.27	0.60	6.55	1.60	5.57	0.43	4.40
	06:05			1.51	5.48	1.30	7.25	0.89	6.84	0.30	6.25	0.57	6.52	1.57	5.54	0.42	4.38
7	07:05			1.50	5.47	1.28	7.23	0.90	6.66	0.28	6.23	0.53	6.48	1.56	5.52	0.40	4.37
	06:05			1.52	5.49	1.24	7.19	0.87	6.82	0.27	6.22	0.50	6.45	1.53	5.50	0.38	4.35
8	07:05			1.51	5.48	1.28	7.23	0.86	6.81	0.29	6.24	0.46	6.41	1.51	5.48	0.36	4.33
	06:05			1.52	5.48	1.25	7.20	0.84	6.79	0.27	6.22	0.44	6.38	1.49	5.46	0.34	4.31
9	07:05			1.54	5.51	1.23	7.16	0.89	6.64	0.30	6.25	0.40	6.35	1.47	5.44	0.32	4.28
	05:05			1.56	5.53	1.21	7.16	0.87	6.82	0.23	6.28	0.38	6.33	1.45	5.42	0.30	4.27
10	07:05			1.57	5.54	1.14	7.09	0.86	6.61	0.28	6.23	0.34	6.29	1.43	5.40	0.28	4.25
	05:05			1.57	5.54	1.13	7.08	0.64	6.79	0.28	6.23	0.32	6.27	1.41	5.38	0.27	4.24
11	07:05			1.58	5.55	1.10	7.05	0.80	6.75	0.27	6.22	0.29	6.24	1.39	5.36	0.25	4.22
	05:05			1.58	5.55	1.13	7.08	0.76	8.71	0.29	6.24	0.27	6.22	1.37	5.34	0.23	4.20
12	07:05			1.61	5.58	1.18	7.13	0.73	6.68	0.31	6.28	0.24	6.19	1.35	5.32	0.21	4.18
	06:05			1.67	5.64	1.16	7.13	0.71	8.68	0.38	6.31	0.25	8.20	1.33	5.30	0.19	4.16
13	07:05			1.77	5.74	1.23	7.16	0.66	6.61	0.41	6.36	0.24	6.19	1.31	5.28	0.17	4.14
	05:05			1.85	5.92	1.23	7.18	0.64	6.59	0.43	6.38	0.24	6.19	1.29	5.26	0.15	4.12
14	07:05			0.30	6.25	1.23	7.18	0.63	6.58	0.45	6.40	0.25	6.20	1.27	5.24	0.13	4.10
	06:05			0.36	6.31	1.16	7.13	0.61	6.56	0.45	6.40	0.27	8.22	1.25	5.22	0.11	4.08
15	07:05		1.83	0.42	6.37	1.20	7.15	0.61	6.56	0.43	6.38	0.34	6.28	1.23	5.20	0.09	4.06
	06:05		1.96	0.45	6.40	1.21	7.16	0.60	6.55	0.43	6.38	0.34	6.29	1.21	5.16	0.08	4.05
16	07:05		2.14	0.45	6.40	1.22	7.17	0.60	6.55	0.42	6.37	0.32	6.27	1.19	5.16	0.06	4.03
	06:05		2.26	0.45	6.40	1.28	7.23	0.59	6.54	0.42	6.37	0.31	6.26	1.18	5.15	0.04	4.01
17	07:05		2.44	0.44	6.39	1.25	7.20	0.60	6.55	0.45	6.40	0.29	6.24	1.15	5.12	0.02	3.99
	05:05		2.57	0.42	6.37	1.28	7.18	0.59	6.54	0.45	6.40	0.28	6.23	1.13	5.10	0.00	3.97
18	07:05	0.79	2.75	0.41	6.36	1.20	7.15	0.57	6.52	0.44	6.38	0.27	6.22	1.11	5.08	1.99	3.95
	05:05	0.87	2.83	0.40	6.35	1.16	7.11	0.56	6.51	0.44	6.38	0.25	6.20	1.09	5.06	1.98	3.94
19	07:05	0.91	2.87	0.41	6.36	1.13	7.08	0.55	6.50	0.42	6.37	0.23	6.18	1.07	5.04	1.86	3.92
	05:05	0.94	2.90	0.40	6.35	1.10	7.05	0.54	6.49	0.41	6.36	0.22	6.17	1.05	5.02	1.95	3.91
20	07:05	0.98	2.94	0.38	6.33	1.09	7.04	0.53	6.48	0.38	6.33	0.20	6.15	1.03	5.00	1.93	3.89
	05:05	1.00	2.96	0.38	6.30	1.09	7.04	0.52	6.47	0.36	6.31	0.19	6.14	1.02	4.88	1.92	3.88
21	07:05	1.08	3.04	0.36	6.31	1.08	7.03	0.51	6.46	0.33	6.23	0.19	6.14	1.00	4.97	1.90	3.86
	06:05	1.11	3.07	0.33	6.28	1.07	7.02	0.50	6.45	0.31	6.26	0.19	6.14	0.98	4.95	1.89	3.85
22	07:05	1.15	3.11	0.33	6.28	1.06	7.01	0.49	6.44	0.28	6.23	0.17	6.12	0.96	4.93	1.87	3.86
	05:05	1.17	3.13	0.32	6.27	1.06	7.01	0.48	6.43	0.28	6.21	0.16	6.11	0.94	4.91	1.95	3.81
23	07:05	1.20	3.16	0.30	6.25	1.15	7.10	0.47	6.42	0.23	6.18	0.14	6.09	0.92	4.89	1.84	3.80
	06:05	1.21	3.17	0.29	6.24	1.15	7.10	0.46	6.41	0.21	8.16	0.12	6.07	0.90	4.87	1.83	3.78
24	07:05	1.24	3.20	0.30	6.25	1.11	7.06	0.50	6.45	0.19	6.14	0.10	6.05	0.87	4.84	1.81	3.77
	05:05	1.26	3.22	0.40	6.36	1.07	7.02	0.55	6.50	0.17	6.12	0.09	6.04	0.86	4.83	1.79	3.75
25	07:05	1.28	3.24	0.79	6.74	1.02	6.97	0.67	6.62	0.16	6.11	0.07	6.02	0.64	4.81	1.79	3.74
	05:05	1.29	3.25	0.83	6.86	0.99	6.94	0.70	6.65	0.15	6.10	0.06	6.01	0.83	4.80	1.77	3.73
26	07:05	1.33	3.29	1.03	6.98	0.94	6.89	0.68	6.63	0.15	6.10	0.04	5.99	0.81	4.78	1.75	3.71
	05:05	1.34	3.30	1.05	7.00	0.92	6.87	0.66	6.61	0.16	6.11	0.02	5.97	0.79	4.76	1.74	3.70
27	07:05	1.37	3.33	1.10	7.05	0.92	6.87	0.65	6.60	0.21	6.16	0.00	5.95	0.77	4.74	1.73	3.68
	05:05	1.38	3.34	1.13	7.08	0.91	6.98	0.64	6.59	0.25	6.20	1.98	5.95	0.75	4.72	1.72	3.68
28	07:05	1.46	3.42	1.14	7.09	0.89	6.64	0.63	6.58	0.28	6.23	1.96	5.93	0.73	4.70	1.70	3.66
	05:05	1.47	3.43	1.11	7.06	0.86	6.81	0.62	6.57	0.38	6.33	1.95	5.92	0.72	4.69	1.69	3.65
29	07:05	1.52	3.48	1.11	7.06	0.84	6.79	0.59	6.54	0.85	6.80	1.93	5.90	0.70	4.67	1.67	3.63
	05:05	1.56	3.52	1.07	7.02	0.83	6.78	0.57	6.52	1.05	7.00	1.91	5.98	0.68	4.85	1.66	3.82
30	07:05	1.70	3.66	1.03	6.98	0.79	6.74	0.54	6.49	1.13	7.09	1.88	5.85	0.86	4.63	1.64	3.60
	05:06	1.77	3.73	1.04	6.99	0.75	6.70	0.52	6.47	1.11	7.06	1.87	5.84	0.65	4.62	1.83	3.59
31	07:06	1.91	3.87			0.76	6.71	0.50	6.45			1.84	5.81			1.62	3.58
	05:06	0.01	3.98			0.74	6.69	0.48	6.43			1.82	5.79			1.61	3.57

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DAY	TIME	JANUARY G.R	JANUARY WL	FEBRUARY G.R	FEBRUARY WL	MARCH G.R	MARCH WL	APRIL G.R	APRIL WL	MAY G.R	MAY WL	JUNE G.R	JUNE WL	JULY G.R	JULY WL	AUGUST G.R	AUGUST WL	SEPT G.R	SEPT WL	OCTOBER G.R	OCTOBER WL	NOVEMBER G.R	NOVEMBER WL	DECEMBER G.R	DECEMBER WL
1	07:05	1.59	3.55	0.96	2.92	0.70	2.86	0.70	2.68	0.90	2.86	0.22	6.17	1.74	7.69	1.68	7.64	1.15	7.10	0.72	6.67	1.50	5.47	0.32	4.29
	06:05	1.58	3.54	0.95	2.81	0.70	2.86	0.68	2.65	0.90	2.86	0.21	6.16	1.79	7.74	1.65	7.60	1.15	7.10	0.75	6.70	1.48	5.45	0.30	4.27
2	07:05	1.56	3.52	0.93	2.89	0.70	2.86	0.69	2.65	0.80	2.86	0.22	6.17	1.95	7.80	1.64	7.59	1.15	7.10	0.77	6.72	1.46	5.43	0.28	4.25
	06:05	1.55	3.51	0.92	2.86	0.70	2.86	0.69	2.65	0.90	2.86	0.21	6.16	1.92	7.87	1.62	7.57	1.19	7.14	0.77	6.72	1.44	5.41	0.26	4.23
3	07:05	1.53	3.49	0.90	2.86	0.70	2.86	0.69	2.65	0.90	2.86	0.21	6.16	1.86	7.83	1.62	7.57	1.29	7.23	0.84	6.79	1.42	5.39	0.24	4.21
	05:05	1.52	3.46	0.89	2.65	0.70	2.86	0.68	2.64	1.06	3.02	0.20	6.15	1.83	7.78	1.81	7.56	1.30	7.25	0.90	6.85	1.40	5.37	0.22	4.19
4	07:05	1.50	3.46	0.87	2.83	0.70	2.86	0.68	2.64	1.08	3.04	0.19	6.14	1.83	7.79	1.84	7.59	1.24	7.19	0.88	6.83	1.38	5.36	0.20	4.17
	06:05	1.49	3.45	0.86	2.62	0.70	2.86	0.68	2.64	1.11	3.07	0.30	6.25	1.83	7.78	1.87	7.82	1.21	7.16	0.84	6.79	1.38	5.33	0.18	4.15
5	07:05	1.47	3.43	0.84	2.80	0.70	2.86	0.89	2.64	1.16	3.12	0.37	6.32	1.79	7.74	1.75	7.70	1.17	7.12	0.79	6.74	1.34	5.31	0.16	4.13
	06:05	1.46	3.42	0.83	2.79	0.70	2.86	0.67	2.63	1.23	3.19	0.39	6.34	1.79	7.73	1.75	7.70	1.13	7.08	0.75	6.70	1.32	5.29	0.14	4.11
6	07:05	1.44	3.40	0.81	2.77	0.70	2.86	0.67	2.63	1.25	3.21	0.52	6.47	1.87	7.62	1.77	7.72	1.12	7.07	0.70	6.66	1.30	5.27	0.12	4.09
	06:05	1.43	3.39	0.80	2.76	0.70	2.86	0.67	2.63	1.31	3.27	0.55	6.50	2.01	7.86	1.79	7.74	1.10	7.05	0.67	6.82	1.28	5.25	0.10	4.07
7	07:05	1.41	3.37	0.78	2.74	0.70	2.86	0.67	2.63	1.33	3.29	0.60	6.55	1.91	7.86	1.62	7.77	1.07	7.02	0.64	6.59	1.26	5.23	0.08	4.05
	06:05	1.40	3.38	0.77	2.73	0.70	2.86	0.66	2.62	1.37	3.33	0.61	6.56	1.86	7.80	1.81	7.76	1.06	7.01	0.62	6.57	1.24	5.21	0.06	4.03
8	07:05	1.38	3.34	0.75	2.71	0.70	2.86	0.68	2.62	1.38	3.34	0.70	6.65	1.77	7.72	1.77	7.72	1.05	7.00	0.57	6.52	1.22	5.19	0.04	4.01
	06:05	1.37	3.33	0.74	2.70	0.89	2.65	0.68	2.62	1.40	3.36	0.78	6.73	1.72	7.67	1.72	7.67	1.04	6.99	0.55	6.50	1.21	5.18	0.02	3.99
9	07:05	1.37	3.33	0.72	2.68	0.89	2.65	0.66	2.62	1.42	3.38	0.84	6.79	1.71	7.86	1.77	7.72	1.02	6.97	0.52	6.47	1.19	5.15	0.00	3.97
	05:05	1.37	3.33	0.71	2.67	0.69	2.65	0.66	2.62	1.43	3.38	0.86	6.81	1.66	7.61	1.73	7.68	1.01	6.96	0.50	6.45	1.17	5.14	1.98	3.94
10	07:05	1.38	3.34	0.70	2.66	0.68	2.65	0.67	2.63	1.64	3.60	0.90	6.85	1.66	7.61	1.89	7.64	0.89	6.93	0.45	6.40	1.15	5.12	1.96	3.92
	05:05	1.41	3.37	0.89	2.65	0.68	2.65	0.68	2.64	1.84	3.80	0.95	6.90	1.63	7.58	1.63	7.58	0.96	6.91	0.43	6.38	1.13	5.10	1.94	3.90
11	07:05	1.44	3.40	0.67	2.63	0.66	2.64	0.72	2.68	0.08	4.05	1.00	6.95	1.59	7.54	1.59	7.54	0.91	6.86	0.39	6.34	1.11	5.08	1.92	3.86
	05:05	1.45	3.41	0.68	2.62	0.68	2.64	0.78	2.72	0.27	4.24	1.05	7.00	1.54	7.46	1.55	7.50	0.88	6.83	0.38	6.33	1.10	5.07	1.90	3.86
12	07:05	1.47	3.43	0.65	2.61	0.68	2.64	0.77	2.73	0.56	4.53	1.17	7.12	1.47	7.42	1.52	7.47	0.95	6.80	0.34	6.29	1.08	5.05	1.68	3.84
	05:05	1.47	3.43	0.64	2.60	0.66	2.64	0.77	2.73	0.75	4.72	1.37	7.32	1.46	7.41	1.50	7.45	0.83	6.78	0.32	6.27	1.06	5.03	1.86	3.82
13	07:05	1.48	3.44	0.62	2.58	0.67	2.63	0.77	2.73	1.03	5.00	1.40	7.36	1.42	7.37	1.47	7.42	0.82	6.77	0.32	6.27	1.04	5.01	1.84	3.80
	05:05	1.48	3.44	0.61	2.57	0.67	2.63	0.77	2.73	1.33	5.30	1.35	7.30	1.38	7.34	1.45	7.40	0.91	6.76	0.30	6.25	1.02	4.99	1.62	3.78
14	07:05	1.47	3.43	0.60	2.56	0.67	2.63	0.77	2.73	1.65	5.62	1.30	7.25	1.39	7.34	1.42	7.37	0.81	6.76	0.27	6.22	1.00	4.97	1.80	3.76
	06:05	1.47	3.43	0.59	2.55	0.67	2.63	0.78	2.74	1.84	5.81	1.26	7.21	1.37	7.32	1.38	7.33	0.81	6.75	0.28	6.23	0.98	4.95	1.78	3.74
15	07:05	1.46	3.42	0.58	2.54	0.69	2.65	0.79	2.74	1.84	5.91	1.21	7.16	1.37	7.32	1.34	7.29	0.81	6.75	0.26	6.21	0.96	4.93	1.76	3.72
	06:05	1.45	3.41	0.57	2.53	0.69	2.65	0.78	2.74	1.96	5.95	1.19	7.14	1.35	7.33	1.31	7.26	0.60	6.75	0.25	6.20	0.94	4.91	1.74	3.70
16	07:05	1.44	3.40	0.55	2.51	0.68	2.64	0.79	2.74	0.12	6.07	1.17	7.12	1.34	7.29	1.29	7.23	0.76	6.71	0.22	8.17	0.92	4.89	1.72	3.68
	06:05	1.43	3.38	0.54	2.50	0.68	2.64	0.78	2.74	0.15	6.10	1.15	7.10	1.29	7.24	1.28	7.21	0.76	6.71	0.20	6.15	0.80	4.87	1.71	3.67
17	07:05	1.41	3.37	0.52	2.48	0.67	2.63	0.78	2.74	0.21	6.16	1.13	7.08	1.28	7.23	1.23	7.21	0.72	6.67	0.17	6.12	0.88	4.85	1.69	3.65
	05:05	1.40	3.38	0.52	2.49	0.67	2.63	0.78	2.74	0.25	6.20	1.12	7.07	1.28	7.23	1.24	7.19	0.80	6.75	0.15	6.10	0.86	4.83	1.68	3.64
18	07:05	1.38	3.34	0.59	2.55	0.67	2.63	0.78	2.74	0.33	6.28	1.06	7.03	1.36	7.31	1.20	7.15	0.66	6.61	0.12	6.07	0.84	4.81	1.86	3.62
	05:05	1.37	3.33	0.56	2.52	0.66	2.62	0.78	2.74	0.44	6.39	1.17	7.12	1.38	7.33	1.18	7.13	0.63	6.58	0.10	6.05	0.82	4.79	1.65	3.61
19	07:05	1.35	3.31	0.64	2.60	0.66	2.62	0.78	2.74	0.48	6.43	1.60	7.55	1.51	7.46	1.18	7.13	0.59	6.54	0.07	6.02	0.80	4.77	1.63	3.59
	05:05	1.34	3.30	0.64	2.60	0.66	2.62	0.78	2.74	0.49	6.43	1.65	7.60	1.86	7.61	1.20	7.15	0.57	6.52	0.06	6.00	0.78	4.78	1.62	3.58
20	07:05	1.32	3.28	0.64	2.60	0.66	2.62	0.78	2.74	0.48	6.43	1.80	7.75	1.86	7.91	1.22	7.17	0.55	6.50	0.02	5.97	0.77	4.74	1.60	3.56
	05:05	1.31	3.27	0.64	2.60	0.66	2.62	0.78	2.74	0.49	8.44	1.60	7.75	1.86	7.81	1.22	7.17	0.53	6.49	0.00	5.95	0.75	4.72	1.58	3.54
21	07:05	1.29	3.25	0.64	2.60	0.68	2.62	0.78	2.74	0.48	8.43	1.73	7.68	1.94	7.89	1.23	7.16	0.51	6.46	1.98	5.95	0.73	4.70	1.56	3.52
	06:05	1.28	3.24	0.64	2.60	0.65	2.81	0.77	2.73	0.46	6.43	1.89	7.84	2.06	6.01	1.26	7.21	0.49	6.44	1.96	5.93	0.71	4.68	1.55	3.51
22	07:05	1.28	3.22	0.68	2.62	0.65	2.61	0.77	2.73	0.46	6.41	1.69	7.64	2.15	8.10	1.32	7.27	0.44	6.39	1.93	5.90	0.69	4.66	1.63	3.48
	05:05	1.25	3.21	0.67	2.63	0.65	2.61	0.77	2.73	0.45	6.40	1.86	7.61	2.11	8.06	1.39	7.34	0.43	6.38	1.91	5.88	0.67	4.64	1.52	3.48
23	07:05	1.23	3.19	0.67	2.83	0.65	2.81	0.77	2.73	0.43	6.38	1.62	7.57	2.09	6.04	1.39	7.33	0.46	6.41	1.88	5.85	0.65	4.62	1.61	3.47
	06:05	1.22	3.19	0.67	2.63	0.65	2.61	0.76	2.72	0.42	6.37	1.58	7.53	2.07	6.02	1.35	7.30	0.46	6.41	1.86	5.83	0.63	4.60	1.50	3.46
24	07:05	1.20	3.16	0.68	2.64	0.65	2.81	0.76	2.72	0.40	6.35	1.55	7.50	2.03	7.98	1.35	7.30	0.43	6.38	1.83	5.80	0.81	4.58	1.48	3.44
	05:05	1.18	3.14	0.69	2.64	0.65	2.61	0.76	2.72	0.38	6.34	1.53	7.48	2.00	7.95	1.38	7.33	0.41	6.38	1.81	5.78	0.58	4.56	1.47	3.43
25	07:05	1.16	3.12	0.68	2.65	0.65	2.61	0.64	2.80	0.38	6.33	1.52	7.47	1.97	7.82	1.34	7.29	0.38	6.38	1.79	5.75	0.47	4.44	1.46	3.42
	05:05	1.15	3.11	0.68	2.85	0.65	2.81	0.85	2.91	0.36	6.31	1.51	7.46	1.93	7.86	1.29	7.23	0.37	6.32	1.76	5.73	0.55	4.52	1.45	3.41
26	07:05	1.13	3.09	0.70	2.86	0.66	2.62	0.86	2.82	0.34	6.29	1.50	7.45	1.91	7.86	1.23	7.16	0.38	6.33	1.74	5.71	0.52	4.49	1.43	3.39
	05:05	1.12	3.08	0.70	2.66	0.63	2.62	0.86	2.82	0.33	6.29	1.49	7.44	1.88	7.84	1.21	7.16	0.38	6.33	1.72	5.69	0.50	4.47	1.42	3.38
27	07:05	1.10	3.06	0.70	2.68	0.70	2.66	0.97	2.83	0.31	6.23	1.48	7.43	1.86	7.81	1.26	7.21	0.40	6.35	1.70	5.67	0.48	4.45	1.40	3.36
	05:05	1.09	3.05	0.70	2.86	0.70	2.66	0.87	2.83	0.30	6.25	1.48	7.43	1.82	7.77	1.28	7.23	0.38	6.33	1.68	5.65	0.46	4.43	1.38	3.35
28	07:05	1.07	3.03	0.70	2.86	0.70	2.68	0.96	2.84	0.28	8.23	1.47	7.42	1.80	7.75	1.35	7.30	0.52	6.47	1.66	5.63	0.44	4.41	1.37	3.33
	05:05	1.08	3.02	0.70	2.66	0.70	2.68	0.89	2.85	0.27	6.22	1.47	7.42	1.78	7.73	1.35	7.30	0.54	6.49	1.84	5.61	0.42	4.39	1.36	3.32
29	07:05	1.04	3.00			0.70	2.66	0.89	2.85	0.24	6.19	1.56	7.51	1.75	7.70	1.34	7.29	0.66	6.61	1.61	5.58	0.40	4.37	1.36	3.31
	05:05	1.03	2.98			0.70	2.66	0.89	2.85	0.23	6.19	1.54	7.49	1.73	7.68	1.33	7.28	0.71	6.66	1.59	5.56	0.39	4.35	1.34	3.30
30	07:05	1.01	2.97			0.70	2.86	0.88	2.85	0.20	6.15	1.64	7.59	1.75	7.70	1.28	7.23	0.76	6.71	1.57	5.54	0.36	4.33	1.32	3.28
	05:06	1.00	2.96			0.70	2.66	0.89	2.85	0.19	6.14	1.67	7.62	1.73	7.68	1.25	7.20	0.75	6.70	1.56	5.53	0.34	4.31	1.31	3.27
31	07:06	0.88	2.94			0.70	2.68			0.23	6.18			1.73	7.68	1.20	7.15			1.54	5.51			1.29	3.25
	05:06	0.97	2.93			0.70	2.66			0.22	6.17			1.71	7.86	1.17	7.12			1.52	5.49			1.28	3.24

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DAY	TIME	JANUARY G.R	JANUARY WL	FEBRUARY G.R	FEBRUARY WL	MARCH G.R	MARCH WL	APRIL G.R	APRIL WL	MAY G.R	MAY WL
1	07:05	1.26	3.22	0.51	2.47		2.44	0.74	2.70	1.10	3.08
	06:05	1.25	3.21	0.50	2.46		2.44	0.78	2.74	1.10	3.06
2	07:05	1.23	3.19		2.46		2.44	0.84	2.80	1.10	3.06
	06:05	1.22	3.18		2.46		2.44	0.85	2.91	1.10	3.06
3	07:05	1.20	3.16		2.48		2.44	0.86	2.82	1.10	3.06
	05:05	1.19	3.15		2.46		2.43	0.87	2.83	1.10	3.06
4	07:05	1.17	3.13		2.46		2.43	0.88	2.84	1.10	3.06
	06:05	1.16	3.12		2.46		2.43	0.89	2.85	1.10	3.06
5	07:05	1.14	3.10		2.46		2.43	0.90	2.86	1.11	3.07
	06:05	1.13	3.09		2.46		2.43	0.91	2.87	1.11	3.07
6	07:05	1.11	3.07		2.46		2.43	0.92	2.88	1.11	3.07
	06:05	1.10	3.06		2.46		2.43	0.93	2.88	1.11	3.07
7	07:05	1.08	3.04		2.46		2.43	0.84	2.80	1.11	3.07
	06:05	1.07	3.03		2.46		2.43	0.95	2.91	1.11	3.07
8	07:05	1.05	3.01		2.46		2.43	0.97	2.93	1.11	3.07
	06:05	1.04	3.00		2.46		2.43	0.98	2.94	1.11	3.07
9	07:05	1.03	2.99		2.46		2.43	0.99	2.95	1.12	3.08
	05:05	1.02	2.98		2.46		2.42	1.00	2.86	1.12	3.08
10	07:05	1.01	2.97		2.46		2.42	1.00	2.96	1.12	3.08
	05:05	1.00	2.96		2.45		2.42	1.00	2.96	1.12	3.06
11	07:05	0.99	2.95		2.46		2.42	1.00	2.96	1.12	3.08
	05:05	0.98	2.94		2.46		2.42	1.00	2.96	1.12	3.08
12	07:05	0.96	2.92		2.46		2.42	1.00	2.96	1.12	3.08
	06:05	0.95	2.91		2.45		2.42	1.00	2.96	1.12	3.06
13	07:05	0.93	2.89		2.45		2.42	1.00	2.96	1.12	3.08
	05:05	0.92	2.88		2.45		2.42	1.00	2.96	1.12	3.09
14	07:05	0.80	2.86		2.45		2.42	1.00	2.96	1.12	3.06
	06:05	0.88	2.84		2.45		2.42	1.00	2.98	1.12	3.08
15	07:05	0.86	2.82		2.45		2.42	1.00	2.96	1.12	3.08
	06:05	0.85	2.81		2.45		2.42	1.00	2.96	1.12	3.08
16	07:05	0.84	2.80		2.45		2.42	1.00	2.96	1.14	3.10
	06:05	0.83	2.78		2.45		2.42	1.00	2.86	1.15	3.11
17	07:05	0.91	2.77		2.45		2.42	1.00	2.96	1.18	3.12
	05:05	0.80	2.78		2.45		2.42	1.00	2.96	1.22	3.16
18	07:05	0.80	2.78		2.45		2.42	1.00	2.86	1.27	3.23
	05:05	0.79	2.75		2.45		2.42	1.00	2.98	1.40	3.36
19	07:05	0.79	2.75		2.45		2.43	1.00	2.86	1.60	3.56
	05:05	0.79	2.75		2.44		2.43	1.00	2.96	1.74	3.70
20	07:05	0.79	2.75		2.44		2.43	1.00	2.98	1.92	3.88
	05:05	0.78	2.74		2.44		2.43	1.02	2.96	0.04	4.01
21	07:05	0.77	2.73		2.44		2.43	1.02	2.98	0.22	4.19
	06:05	0.77	2.73		2.44		2.43	1.02	2.98	0.34	4.31
22	07:05	0.76	2.72		2.44		2.45	1.02	2.99	0.44	4.41
	05:05	0.75	2.71		2.44		2.45	1.02	2.98	0.55	4.52
23	07:05	0.74	2.70		2.45		2.46	1.03	2.99	0.80	4.67
	06:05	0.73	2.69		2.45		2.45	1.03	2.99	0.95	4.92
24	07:05	0.72	2.69		2.45		2.45	1.04	3.00	1.03	5.00
	05:05	0.71	2.67		2.45		2.46	1.04	3.00	1.07	5.04
25	07:05	0.68	2.65		2.45		2.45	1.09	3.04	1.14	5.11
	05:05	0.68	2.64		2.44		2.45	1.09	3.04	1.19	5.15
26	07:05	0.66	2.62		2.44		2.46	1.09	3.05	1.25	5.22
	05:05	0.65	2.61		2.44		2.45	1.08	3.05	1.28	5.25
27	07:05	0.63	2.59		2.44		2.47	1.10	3.06	1.31	5.28
	05:05	0.62	2.58		2.44		2.47	1.10	3.06		
28	07:05	0.60	2.56		2.44		2.51	1.10	3.08		
	05:05	0.59	2.55		2.44		2.50	1.10	3.06		
29	07:05	0.57	2.53				2.52	1.10	3.06		
	05:05		2.49				2.52	1.10	3.06		
30	07:05		2.46				2.52	1.10	3.06		
	05:06		2.46			0.56	2.52	1.10	3.06		
31	07:06		2.46			0.63	2.59				
	05:06		2.42			0.68	2.64				

ZERO VALUES: 1.955 H2; 3.965 H1

Project Monitoring Program

SHANIR HAOR FCD PROJECT

Baulai River Water Level (m PWD) at Tahirpur (NERP Station)

1992

DAY	TIME	MAY GR	MAY WL	JUNE GR	JUNE WL	JULY GR	JULY WL	AUGUST GR	AUGUST WL	SEPT GR	SEPT WL	OCTOBER GR	OCTOBER WL	NOVEMBER GR	NOVEMBER WL	DECEMBER GR	DECEMBER WL
1	07:00			1.12	5.53	0.60	6.89	0.29	6.88	0.00	6.38	0.80	6.89	1.35	5.76	0.14	4.55
	05:00			1.10	5.51	0.60	6.99	0.28	6.67	0.03	6.42	0.55	6.94	1.33	5.74	0.13	4.54
2	07:00			1.07	5.48	0.60	6.99	0.29	6.69	1.99	6.40	0.49	6.88	1.30	5.71	0.10	4.51
	05:00			1.07	5.48	0.59	6.98	0.27	6.66	1.86	6.39	0.45	6.84	1.29	5.70	0.08	4.49
3	07:00			1.09	5.50	0.69	7.08	0.25	6.64	1.98	6.37	0.39	6.78	1.28	5.67	0.07	4.48
	05:00			1.08	5.49	0.69	7.08	0.24	6.63	1.96	6.36	0.36	6.75	1.24	5.65	0.06	4.47
4	07:00			1.07	5.48	0.95	7.24	0.25	6.64	1.93	6.34	0.31	6.70	1.22	5.63	0.03	4.44
	05:00			1.07	5.49	0.95	7.34	0.28	6.62	1.91	6.32	0.29	6.67	1.21	5.62	0.02	4.43
5	07:00			1.07	5.48	0.91	7.30	0.28	6.87	1.91	6.32	0.23	6.62	1.19	5.59	1.76	4.41
	05:00			1.06	5.47	0.89	7.28	0.32	6.71	1.90	6.31	0.19	6.58	1.17	5.58	1.75	4.40
6	07:00			1.06	5.47	0.89	7.28	0.38	6.77	1.89	6.30	0.16	6.55	1.14	5.55	1.72	4.37
	05:00			1.06	5.47	0.95	7.24	0.43	6.82	1.88	6.29	0.13	6.52	1.12	5.53	1.71	4.36
7	07:00			1.05	5.46	0.61	7.20	0.45	6.84	1.86	6.27	0.09	6.48	1.09	5.50	1.66	4.33
	05:00			1.07	5.48	0.78	7.17	0.45	6.84	1.84	6.25	0.06	6.45	1.08	5.49	1.67	4.32
8	07:00			1.08	5.49	0.82	7.21	0.42	6.81	1.84	6.25	0.01	6.40	1.05	5.46	1.64	4.29
	05:00			1.07	5.48	0.82	7.21	0.40	6.79	1.84	6.25	0.00	6.38	1.03	5.44	1.62	4.27
9	07:00			1.08	5.49	0.79	7.19	0.45	6.84	1.86	6.27	1.95	6.36	1.00	5.41	1.60	4.25
	05:00			1.12	5.53	0.77	7.16	0.43	6.82	1.86	6.27	1.93	6.34	0.99	5.40	1.58	4.23
10	07:00			1.12	5.53	0.73	7.12	0.41	6.80	1.85	6.26	1.91	6.32	0.96	5.37	1.56	4.21
	05:00			1.12	5.53	0.69	7.08	0.39	6.78	1.84	6.25	1.89	6.30	0.95	5.36	1.54	4.19
11	07:00			1.11	5.52	0.66	7.05	0.34	6.73	1.84	6.25	1.84	6.25	0.91	5.32	1.52	4.17
	05:00			1.14	5.55	0.67	7.06	0.32	6.71	1.88	6.29	1.83	6.24	0.91	5.32	1.50	4.15
12	07:00			1.15	5.56	0.74	7.13	0.28	6.67	1.90	6.31	1.80	6.21	0.89	5.30	1.48	4.13
	05:00			1.18	5.59	0.76	7.15	0.26	6.65	1.93	6.34	1.81	6.22	0.87	5.28	1.46	4.11
13	07:00			1.74	6.15	0.81	7.20	0.21	6.60	1.98	6.39	1.80	6.21	0.84	5.25	1.44	4.09
	05:00			1.80	6.21	0.81	7.20	0.20	6.59	2.00	6.41	1.81	6.22	0.83	5.24	1.42	4.07
14	07:00			1.93	6.34	0.80	7.19	0.19	6.58	2.00	6.41	1.83	6.24	0.80	5.21	1.40	4.05
	05:00			1.96	6.37	0.74	7.13	0.17	6.56	2.00	6.41	1.84	6.25	0.79	5.20	1.38	4.03
15	07:00			0.03	6.42	0.78	7.17	0.17	6.56	2.00	6.41	1.90	6.31	0.77	5.18	1.36	4.01
	05:00			0.02	6.41	0.77	7.16	0.16	6.55	1.99	6.40	1.90	6.31	0.76	5.17	1.34	3.99
16	07:00			0.02	6.41	0.79	7.17	0.14	6.53	1.98	6.39	1.89	6.28	0.74	5.15	1.32	3.97
	05:00			0.01	6.40	0.83	7.22	0.14	6.53	1.97	9.38	1.87	6.28	0.72	5.13	1.31	3.96
17	07:00			0.01	6.40	0.81	7.20	0.15	6.54	2.00	6.41	1.84	9.25	0.88	5.10	1.29	3.94
	05:00			0.00	6.39	0.79	7.19	0.14	6.53	0.01	6.40	1.84	6.25	0.67	5.08	1.27	3.82
18	07:00			1.96	6.37	0.75	7.14	0.10	6.49	0.01	6.40	1.82	6.23	0.64	5.05	1.25	3.90
	05:00			1.96	6.37	0.73	7.12	0.11	6.50	2.00	6.41	1.61	6.22	0.63	5.04	1.23	3.88
19	07:00			1.97	6.38	0.69	7.08	0.10	6.49	1.98	6.39	1.79	6.20	0.60	5.01	1.21	3.88
	05:00			1.97	6.38	0.67	7.06	0.09	6.48	1.96	6.37	1.79	6.20	0.59	5.00	1.20	3.85
20	07:00			1.87	6.38	0.65	7.04	0.07	6.46	1.94	6.35	1.76	6.17	0.57	4.98	1.19	3.63
	05:00			1.84	6.35	0.65	7.04	0.07	6.46	1.92	6.33	1.75	6.16	0.55	4.97	1.16	3.61
21	07:00	0.89	5.29	1.93	6.34	0.62	7.01	0.06	6.45	1.89	6.30	1.74	6.15	0.53	4.94	1.14	3.79
	05:00	0.84	5.25	1.93	6.34	0.82	7.01	0.04	6.43	1.87	6.28	1.74	6.15	0.52	4.93	1.14	3.78
22	07:00	0.79	5.20	1.89	6.30	0.82	7.01	0.04	9.43	1.84	6.25	1.72	6.13	0.49	4.90	1.11	3.76
	05:00	0.80	5.21	1.89	6.30	0.61	7.00	0.03	6.42	1.84	6.25	1.72	6.13	0.48	4.89	1.09	3.74
23	07:00	0.82	5.23	1.88	6.29	0.67	7.06	0.02	6.41	1.79	6.20	1.70	6.11	0.45	4.96	1.07	3.72
	05:00	0.84	5.25	1.67	6.28	0.69	7.08	0.01	6.40	1.78	6.19	1.88	6.09	0.45	4.86	1.06	3.71
24	07:00	0.86	5.27	1.89	6.29	0.66	7.05	0.08	6.47	1.75	6.16	1.65	6.06	0.42	4.83	1.04	3.69
	05:00	0.87	5.28	0.00	6.39	0.63	7.02	0.14	6.53	1.74	6.15	1.65	6.06	0.41	4.82	1.03	3.68
25	07:00	0.89	5.29	0.50	6.89	0.56	6.95	0.22	6.61	1.72	6.13	1.61	6.02	0.38	4.78	1.01	3.88
	05:00	0.89	5.30	0.53	6.92	0.54	6.93	0.27	6.66	1.72	6.13	1.60	6.01	0.37	4.78	1.00	3.85
26	07:00	0.92	5.36	0.63	7.02	0.50	6.89	0.24	6.63	1.72	6.13	1.59	6.00	0.34	4.75	0.98	3.63
	05:00	0.95	5.36	0.60	6.99	0.48	6.87	0.23	6.62	1.72	6.13	1.57	5.98	0.33	4.74	0.96	3.61
27	07:00	0.98	5.39	0.70	7.09	0.47	6.86	0.21	6.60	1.77	6.19	1.55	5.98	0.30	4.71	0.94	3.59
	05:00	1.00	5.41	0.74	7.13	0.48	6.87	0.20	6.59	1.83	6.24	1.54	5.95	0.29	4.70	0.92	3.57
28	07:00	1.07	5.48	0.71	7.10	0.44	6.83	0.16	6.55	1.83	6.24	1.51	5.92	0.27	4.68	0.90	3.55
	05:00	1.09	5.50	0.67	7.06	0.42	6.81	0.16	6.55	1.97	6.38	1.50	5.91	0.25	4.66	0.88	3.53
29	07:00	1.11	5.52	0.65	7.04	0.40	6.79	0.14	6.53	0.50	6.89	1.48	5.89	0.22	4.63	0.96	3.51
	05:00	1.13	5.54	0.65	7.04	0.39	6.79	0.13	6.52	0.65	7.04	1.46	5.87	0.21	4.62	0.85	3.50
30	07:00	1.13	5.54	0.60	6.98	0.35	6.74	0.10	6.49	0.69	7.08	1.44	5.85	0.19	4.59	0.83	3.48
	05:00	1.14	5.55	0.60	6.98	0.31	6.70	0.07	6.46	0.67	7.06	1.42	5.83	0.17	4.58	0.82	3.47
31	07:00	1.13	5.54			0.32	6.71	0.05	6.44			1.38	5.80			0.81	3.46
	05:00	1.12	5.53			0.30	6.69	0.03	6.42			1.36	5.78			0.79	3.44

1993

DAY	TIME	JANUARY GR	JANUARY WL	FEBRUARY GR	FEBRUARY WL	MARCH GR	MARCH WL	APRIL GR	APRIL WL	MAY GR	MAY WL	JUNE GR	JUNE WL	JULY GR	JULY WL	AUGUST GR	AUGUST WL	SEPT GR	SEPT WL	OCTOBER GR	OCTOBER WL	NOVEMBER GR	NOVEMBER WL	DECEMBER GR	DECEMBER WL
1	07:00	0.77	3.42	0.22	2.87	0.10	4.51	1.55	4.20	1.47	4.12	1.77	6.18	1.31	7.70	1.25	7.64	0.70	7.08	0.28	6.67	0.94	6.47	1.49	4.32
	05:00	0.76	3.41	0.21	2.86	0.07	4.48	1.51	4.16	1.52	4.17	1.77	6.19	1.35	7.74	1.20	7.59	0.70	7.09	0.30	6.88	0.92	5.45	1.47	4.30
2	07:00	0.74	3.38	0.19	2.84	0.02	4.43	1.45	4.10	1.57	4.22	1.78	6.19	1.42	7.81	1.20	7.59	0.69	7.07	0.32	6.71	0.90	5.43	1.44	4.27
	05:00	0.73	3.36	0.17	2.82	1.76	4.41	1.42	4.07	1.60	4.25	1.77	6.18	1.47	7.86	1.17	7.56	0.75	7.14	0.32	6.71	0.88	5.41	1.42	4.25
3	07:00	0.71	3.36	0.15	2.60	1.72	4.37	1.38	4.01	1.63	4.28	1.76	6.17	1.44	7.83	1.18	7.57	0.83	7.22	0.42	6.81	0.86	5.39	1.40	4.28
	05:00	0.70	3.35	0.14	2.79	1.88	4.33	1.31	3.96	1.75	4.40	1.77	6.18	1.37	7.76	1.16	7.55	0.63	7.22	0.44	6.63	0.86	6.39	1.39	4.22
4	07:00	0.69	3.33	0.12	2.77	1.63	4.28	1.22	3.67	0.29	4.70	1.86	6.27	1.39	7.79	1.21	7.80	0.80	7.19	0.43	6.82	0.63	5.36	1.37	4.20
	05:00	0.88	3.31	0.11	2.76	1.59	4.24	1.17	3.62	0.38	4.79	1.89	6.30	1.36	7.77	1.25	7.64	0.75	7.14	0.39	6.78	0.82	5.35	1.36	4.16
5	07:00	0.64	3.29	0.10	2.75	1.54	4.19	1.09	3.74	0.64	5.06	1.98	6.39	1.38	7.77	1.34	7.73	0.70	7.09	0.35	6.74	0.80	5.33	1.32	4.15
	05:00	0.64	3.29	0.09	2.74	1.50	4.15	1.03	3.68	0.80	5.31	1.98	6.40	1.36	7.72	1.34	7.73	0.69	7.07	0.30	6.69	0.79	5.32	1.31	4.14
6	07:00	0.63	3.28	0.07	2.72	1.44	4.08	0.97	3.62	0.94	5.35	0.06	6.45	1.45	7.84	1.37	7.76	0.67	7.06	0.26	6.65	0.77	5.30	1.29	4.12
	05:00	0.61	3.26	0.06	2.71	1.40	4.05	0.81	3.56	0.92	5.33	0.07	6.46	1.56	7.95	1.38	7.77	0.86	7.05	0.23	6.62	0.75	5.28	1.28	4.11
7	07:00	0.59	3.24	0.04	2.69	1.36	4.00	0.95	3.50	0.92	5.33	0.12	6.51	1.48	7.87	1.42	7.81	0.63	7.02	0.19	6.58	0.73	5.26	1.26	4.09
	05:00	0.57	3.22	0.03	2.68	1.31	3.96	0.80	3.45	0.94	5.35	0.16	6.55	1.41	7.80	1.38	7.77	0.62	7.01	0.17	6.56	0.72	5.25	1.24	4.07
8	07:00	0.57	3.22	0.02	2.67	1.26	3.91	0.73	3.38	1.04	5.45	0.28	6.67	1.32	7.71	1.32	7.71	0.80	6.99	0.12	6.51	0.70	5.23	1.21	4.04
	05:00	0.57	3.22	0.01	2.66	1.23	3.88	0.69	3.34	1.08	5.49	0.36	6.75	1.27	7.66	1.26	7.65	0.59	6.98	0.11	6.50	0.68	5.21	1.20	4.03
9	07:00	0.62	3.27	1.10	3.75	1.18	3.83	0.64	3.29	1.13	5.54	0.40	6.79	1.24	7.63	1.30	7.69	0.58	6.97	0.07	6.48	0.64	5.17	1.19	4.01
	05:00	0.66	3.31	1.09	3.74	1.15	3.80	0.61	3.26	1.15	5.56	0.42	6.81	1.21	7.60	1.27	7.66	0.57	6.96	0.04	6.43	0.63	5.16	1.17	4.00
10	07:00	0.78	3.44	1.07	3.72	1.11	3.76	0.57	3.22	1.16	5.57	0.47	6.86	1.22	7.61	1.23	7.62	0.53	6.92	1.88	9.41	0.61	5.14	1.15	3.98
	05:00	0.61	3.46	1.06	3.71	1.07	3.72	0.54	3.19	1.16	5.57	0.50	6.89	1.16	7.57	1.19	7.58	0.51	6.90	1.86	6.41	0.59	5.12	1.13	3.96
11	07:00	0.63	3.48	1.04	3.68	1.02	3.67	0.65	3.30	1.15	5.56	0.55	6.94	1.14	7.53	1.14	7.53	0.47	6.86	1.83	6.36	0.57	5.10	1.10	3.93
	05:00	0.62	3.47	1.03	3.68	0.99	3.64	0.79	3.43	1.15	5.56	0.65	7.04	1.10	7.48	1.10	7.49	0.43	6.82	1.81	6.34	0.55	5.08	1.08	3.81
12	07:00	0.82	3.47	1.01	3.69	0.95	3.80	0.66	3.51	1.20	5.61	0.61	7.20	1.03	7.42	1.08	7.47	0.40	6.79	1.78	6.31	0.52	5.05	1.05	3.86
	05:00	0.61	3.46	1.00	3.65	0.92	3.57	0.90	3.55	1.31	5.72	0.92	7.31	1.01	7.40	1.06	7.45	0.38	6.77	1.76	6.29	0.51	5.04	1.03	3.88
13	07:00	0.79	3.44	0.89	3.63	0.87	3.52	0.92	3.57	1.38	5.80	0.95	7.34	0.97	7.36	1.04	7.43	0.37	6.76	1.76	6.29	0.48	5.02	1.00	3.83
	05:00	0.78	3.44	0.97	3.62	0.84	3.49	0.92	3.57	1.35	5.76	0.91	7.30	0.93	7.32	1.00	7.39	0.36	6.75	1.74	6.27	0.48	5.01	0.99	3.82
14	07:00	0.78	3.43	0.97	3.62	0.79	3.44	0.92	3.57	1.39	5.80	0.84	7.23	0.93	7.32	0.97	7.36	0.35	6.74	1.71	6.24	0.45	4.98	0.97	3.80
	05:00	0.77	3.42	0.99	3.64	0.75	3.40	0.91	3.56	1.43	5.84	0.81	7.20	0.91	7.30	0.94	7.33	0.35	6.74	1.72	6.25	0.44	4.97	0.96	3.79
15	07:00	0.75	3.40	1.06	3.71	0.71	3.36	0.91	3.56	1.48	5.89	0.77	7.16	0.89	7.28	0.90	7.29	0.37	6.76	1.70	6.23	0.42	4.95	0.94	3.77
	05:00	0.74	3.39	1.04	3.68	0.70	3.35	0.90	3.55	1.51	5.92	0.73	7.12	0.87	7.26	0.87	7.26	0.35	6.74	1.68	8.21	0.40	4.93	0.93	3.76
16	07:00	0.72	3.37	1.05	3.70	0.68	3.33	0.89	3.54	1.68	6.09	0.70	7.09	0.96	7.27	0.63	7.22	0.32	6.71	1.65	6.18	0.38	4.91	0.92	3.75
	05:00	0.71	3.36	1.05	3.70	0.67	3.32	0.87	3.52	1.70	6.11	0.68	7.08	0.87	7.26	0.60	7.19	0.31	6.70	1.85	6.18	0.38	4.89	0.90	3.73
17	07:00	0.69	3.34	1.04	3.69	0.65	3.30	0.83	3.48	1.76	6.17	0.87	7.06	0.96	7.25	0.92	7.21	0.27	6.66	1.61	8.14	0.36	4.98	0.88	3.71
	05:00	0.68	3.33	1.04	3.69	0.64	3.29	0.91	3.46	1.80	6.21	0.86	7.05	0.84	7.23	0.79	7.18	0.25	6.64	1.60	8.13	0.32	4.95	0.87	3.70
18	07:00	0.66	3.31	1.06	3.71	0.62	3.27	0.78	3.43	1.94	6.35	0.61	7.00	0.90	7.29	0.75	7.14	0.22	6.91	1.57	6.10	0.30	4.53	0.95	3.68
	05:00	0.65	3.30	0.08	2.71	0.61	3.26	0.77	3.42	0.03	6.42	0.63	7.02	0.93	7.32	0.73	7.12	0.19	6.58	1.55	6.08	0.29	4.32	0.84	3.67
19	07:00	0.63	3.28	0.50	3.15	0.59	3.24	0.74	3.39	0.04	6.43	1.20	7.59	1.08	7.47	0.75	7.14	0.15	6.54	1.52	6.05	0.27	4.80	0.82	3.65
	05:00	0.62	3.27	0.90	3.55	0.57	3.22	0.72	3.37	0.04	6.43	1.25	7.64	1.22	7.81	0.74	7.13	0.11	6.50	1.50	6.03	0.25	4.78	0.81	3.64
20	07:00	0.60	3.25	1.28	3.93	0.55	3.20	0.68	3.33	0.04	6.43	1.34	7.73	1.35	7.74	0.79	7.17	0.10	6.49	1.47	6.00	0.23	4.76	0.79	3.62
	05:00	0.58	3.23	1.46	4.11	0.52	3.17	0.66	3.31	0.03	6.42	1.33	7.72	1.45	7.84	0.78	7.15	0.06	6.45	1.45	5.98	0.21	4.74	0.78	3.61
21	07:00	0.56	3.21	1.62	4.27	0.48	3.13	0.60	3.25	0.06	6.42	1.28	7.67	1.44	7.63	0.76	7.17	0.07	6.46	1.42	5.95	0.18	4.72	0.76	3.59
	05:00	0.55	3.20	1.73	4.36	0.46	3.11	0.58	3.28	0.02	6.41	1.25	7.64	1.58	7.97	0.63	7.22	0.04	6.43	1.40	5.93	0.17	4.70	0.74	3.57
22	07:00	0.53	3.16	0.11	4.52	0.43	3.08	0.53	3.18	0.00	6.39	1.23	7.62	1.71	6.10	0.92	7.31	1.89	6.29	1.37	5.90	0.15	4.68	0.72	3.55
	05:00	0.52	3.17	0.12	4.53	0.42	3.07	0.52	3.17	0.00	6.39	1.19	7.58	1.67	6.06	0.94	7.33	1.96	6.27	1.35	5.98	0.13	4.06	0.71	3.54
23	07:00	0.50	3.15	0.16	4.58	0.41	3.06	0.48	3.14	1.98	6.39	1.16	7.55	1.63	8.02	0.93	7.32	0.03	6.42	1.32	5.85	0.11	4.64	0.69	3.52
	05:00	0.49	3.14	0.23	4.64	0.41	3.06	0.49	3.13	1.97	6.38	1.13	7.52	1.60	7.99	0.89	7.28	0.01	6.40	1.30	5.63	0.09	4.62	0.67	3.50
24	07:00	0.47	3.12	0.29	4.70	0.52	3.17	0.46	3.13	1.85	6.36	1.09	7.48	1.56	7.95	0.94	7.33	1.66	6.27	1.27	5.80	0.06	4.59	0.85	3.48
	05:00	0.45	3.10	0.31	4.72	0.57	3.22	0.47	3.12	1.84	6.35	1.08	7.47	1.54	7.93	0.93	7.32	1.84	6.25	1.25	5.78	0.04	4.57	0.84	3.47
25	07:00	0.43	3.08	0.32	4.73	0.69	3.34	0.59	3.24	1.83	6.34	1.05	7.44	1.49	7.88	0.87	7.26	1.82	6.23	1.23	5.76	0.02	4.55	0.82	3.45
	05:00	0.42	3.07	0.31	4.72	0.78	3.43	0.63	3.29	1.91	6.32	1.03	7.42	1.46	7.85	0.83	7.22	1.81	6.22	1.21	5.74	1.70	4.53	0.61	3.44
26	07:00	0.40	3.05	0.29	4.70	1.02	3.67	0.70	3.35	1.88	6.29	1.06	7.45	1.44	7.83	0.80	7.19	1.81	6.22	1.18	5.71	1.69	4.52	0.59	3.42
	05:00	0.39	3.04	0.27	4.68	1.10	3.75	0.74	3.39	1.87	6.28	1.03	7.42	1.42	7.81	0.76	7.15	1.80	6.21	1.16	5.69	1.67	4.50	0.57	3.40
27	07:00	0.37	3.02	0.23	4.64	1.30	3.95	0.82	3.47	1.84	6.25	1.06	7.45	1.39	7.78	0.82	7.21	1.93	6.24	1.13	5.88	1.65	4.46	0.55	3.38
	05:00	0.35	3.00	0.21	4.62	1.45	4.10	0.85	3.50	1.85	6.28	1.05	7.44	1.37	7.76	0.83	7.22	1.82	6.23	1.12	5.85	1.63	4.45	0.53	3.36
28	07:00	0.36	2.98	0.17	4.58	1.60	4.25	0.96	3.61	1.91	6.22	1.03	7.42	1.34	7.73	0.90	7.29	0.08	6.47	1.10	5.63	1.61	4.44	0.50	3.33
	05:00	0.32	2.97	0.14	4.55	1.67	4.32	0.98	3.63	1.81	6.22	1.01	7.40	1.32	7.71	0.90	7.29	0.10	6.48	1.08	5.82	1.59	4.42	0.49	3.32
29	07:00	0.30	2.95			1.70	4.35	1.08	3.74	1.78	6.19	1.12	7.51	1.29	7.66	0.90	7.29	0.22	6.61	1.07	5.80	1.57	4.40	0.47	3.30
	05:00	0.29	2.94			1.71	4.36	1.20	3.85	1.77	6.16	1.10	7.49	1.27	7.66	0.89	7.29	0.27	6.66	1.06	5.59	1.56	4.39	0.47	3.30
30	07:00	0.27	2.92			1.70	4.35	1.31	3.96	1.75	6.16	1.20	7.59	1.31	7.70	0.83	7.22	0.31	6.70	1.04	5.57	1.54	4.37	0.46	3.29
	05:00	0.26	2.91			1.67	4.32	1.39	4.04	1.73	6.14	1.22	7.61	1.28	7.67	0.80	7.19	0.31	6.70	1.01	5.54	1.52	4.35	0.45	3.28
31	07:00	0.25	2.90			1.84	4.29			1.79	6.19			1.31	7.70	0.75	7.14			0.97	5.50			0.43	3.28
	05:00	0.24	2.89			1.82	4.27			1.77	6.18			1.26	7.65	0.72	7.11			0.96	5.49			0.42	3.25

1994

DAY	TIME	JANUARY GR	JANUARY WL	FEBRUARY GR	FEBRUARY WL	MARCH GR	MARCH WL	APRIL GR	APRIL WL	MAY GR	MAY WL
1	07:00	0.40	3.23	0.77	2.55	0.37	2.15	1.00	5.53	0.45	4.98
	05:00	0.38	3.22	0.77	2.55	0.37	2.15	0.98	5.51	0.42	4.95
2	07:00	0.37	3.20	0.77	2.55	0.37	2.16	1.08	5.56	0.38	4.92
	05:00	0.36	3.19	0.76	2.54	0.37	2.15	1.05	5.86	0.36	4.69
3	07:00	0.34	3.17	0.74	2.52	0.36	2.14	1.07	5.60	0.32	4.95
	05:00	0.33	3.16	0.74	2.52	0.36	2.14	1.08	5.61	0.28	4.81
4	07:00	0.31	3.14	0.73	2.51	0.36	2.14	1.14	5.67	0.24	4.77
	05:00	0.30	3.13	0.73	2.51	0.36	2.14	1.15	5.86	0.20	4.73
5	07:00	0.28	3.11	0.73	2.51	0.36	2.14	1.15	5.68	0.20	4.73
	05:00	0.27	3.10	0.73	2.51	0.36	2.14	1.14	5.67	0.17	4.70
6	07:00	0.25	3.08	0.72	2.50	0.35	2.13	1.13	5.66	0.16	4.71
	05:00	0.24	3.07	0.72	2.50	0.35	2.13	1.13	5.86	0.19	4.72
7	07:00	0.22	3.05	0.72	2.60	0.35	2.13	1.17	5.70	0.19	4.72
	05:00	0.21	3.04	0.71	2.48	0.36	2.13	1.17	5.70	0.20	4.73
8	07:00	0.19	3.02	0.69	2.47	0.34	2.12	1.16	5.71	0.25	4.79
	05:00	0.18	3.01	0.66	2.46	0.34	2.12	1.08	5.61	0.30	4.63
9	07:00	0.16	2.99	0.69	2.46	0.34	2.12	0.97	5.50	0.37	4.90
	05:00	0.15	2.98	0.68	2.46	0.34	2.12	0.95	5.49	0.41	4.94
10	07:00	0.13	2.96	0.69	2.47	0.34	2.12	0.95	5.48	0.46	4.99
	05:00	0.12	2.95	0.68	2.46	0.34	2.12	0.91	5.44	0.49	5.02
11	07:00	0.10	2.93	0.67	2.45	0.34	2.12	0.90	5.43	0.53	5.06
	05:00	1.14	2.92	0.66	2.44	0.34	2.12	0.90	5.43	0.54	5.07
12	07:00	1.12	2.90	0.65	2.43	0.34	2.12	0.90	5.43	0.57	5.10
	05:00	1.11	2.89	0.64	2.42	0.34	2.12	0.89	5.42	0.57	5.10
13	07:00	1.09	2.87	0.63	2.41	0.34	2.12	0.87	5.40	0.58	5.11
	05:00	1.09	2.87	0.83	2.41	0.34	2.12	0.87	5.40	0.59	5.11
14	07:00	1.08	2.86	0.82	2.40	0.34	2.12	0.85	5.38	0.59	5.12
	05:00	1.07	2.65	0.82	2.40	0.34	2.12	0.83	5.36	0.57	5.10
15	07:00	1.06	2.84	0.61	2.38	0.34	2.12	0.80	5.33	0.57	5.10
	05:00	1.05	2.83	0.60	2.38	0.36	2.14	0.77	5.30	0.57	5.10
16	07:00	1.04	2.62	0.59	2.37	0.36	2.14	0.74	5.27	0.69	5.11
	05:00	1.04	2.92	0.58	2.36	0.37	2.15	0.71	5.24	0.57	5.10
17	07:00	1.04	2.82	0.57	2.35	0.37	2.15	0.67	5.20	0.58	5.11
	05:00	1.03	2.91	0.56	2.34	0.37	2.15	0.64	5.17	0.61	5.14
18	07:00	1.02	2.80	0.55	2.33	0.42	2.20	0.61	5.14	0.61	5.14
	05:00	1.02	2.80	0.54	2.32	0.45	2.23	0.59	5.12	0.60	5.13
19	07:00	1.01	2.79	0.52	2.30	0.48	2.26	0.57	5.10	0.59	5.12
	05:00	1.00	2.79	0.48	2.27	0.49	2.27	0.57	5.10	0.58	5.11
20	07:00	0.98	2.77	0.47	2.25	0.54	2.32	0.56	5.09	0.56	5.09
	05:00	0.96	2.76	0.46	2.24	0.57	2.35	0.58	5.09	0.54	5.07
21	07:00	0.97	2.75	0.44	2.22	0.87	2.65	0.60	5.13	0.51	5.04
	05:00	0.96	2.74	0.43	2.21	1.00	2.78	0.59	5.12	0.49	5.02
22	07:00	0.95	2.73	0.44	2.22	1.38	3.16	0.58	5.12	0.46	4.99
	05:00	0.84	2.72	0.45	2.23	1.70	3.48	0.58	5.11	0.45	4.98
23	07:00	0.92	2.70	0.45	2.23	1.00	3.89	0.59	5.12	0.59	5.12
	05:00	0.91	2.89	0.45	2.23	1.32	4.20	0.57	5.10	0.59	5.12
24	07:00	0.90	2.68	0.44	2.22	0.02	4.55	0.57	5.10	0.59	5.12
	05:00	0.89	2.67	0.43	2.21	0.12	4.65	0.57	5.10	0.59	5.12
25	07:00	0.87	2.65	0.42	2.20	0.25	4.78	0.58	5.11	0.62	5.15
	05:00	0.86	2.64	0.41	2.19	0.33	4.86	0.58	5.11	0.64	5.17
26	07:00	0.95	2.63	0.40	2.16	0.33	4.86	0.62	5.15	0.70	5.23
	05:00	0.84	2.62	0.39	2.17	0.35	4.88	0.62	5.15	0.73	5.26
27	07:00	0.92	2.60	0.36	2.16	0.39	4.92	0.65	5.16	0.76	6.29
	05:00	0.81	2.59	0.38	2.16	0.52	5.05	0.63	5.16		
28	07:00	0.80	2.58	0.38	2.16	0.83	6.36	0.62	6.15		
	05:00	0.79	2.57	0.37	2.15	0.83	5.36	0.60	5.13		
29	07:00	0.79	2.56			0.90	5.43	0.58	5.09		
	05:00	0.78	2.58			0.93	5.46	0.53	5.06		
30	07:00	0.77	2.55			0.93	5.46	0.51	5.04		
	05:00	0.77	2.55			0.93	5.46	0.48	5.01		
31	07:00	0.77	2.55			0.94	5.47				
	05:00	0.77	2.55			0.96	5.46				

ZERO VALUES: 6.388 R1; 4.408 R2; 2.646 R3

Project Monitoring Program

SHANIR HAOR FCD PROJECT

Shanir Haor Water Level (m PWD) at Tahirpur (NERP Station)

DAY	TIME	1992																1993																				1994					
		MAY		JUNE		JULY		AUGUST		SEPT		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPT		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY	
		G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL	G.R.	WL
1	07:10			0.02	4.30	0.69	6.98	0.39	6.66	0.10	6.38	0.70	6.99	1.45	5.73	0.33	4.61	0.17	4.45	0.00	4.28							1.87	6.15	1.40	7.69	1.35	7.64	0.90	7.09	0.38	6.67	1.18	5.44	0.23	4.51	0.09	4.37								
	05:10			0.02	4.30	0.69	6.98	0.38	6.67	0.12	6.41	0.65	6.94	1.43	5.71	0.33	4.61	0.17	4.45	0.00	4.28							1.87	6.15	1.44	7.73	1.30	7.59	0.90	7.09	0.40	6.68	1.14	5.42	0.23	4.51	0.09	4.37								
2	07:10			0.10	4.38	0.69	6.98	0.38	6.67	0.09	6.36	0.59	6.88	1.40	5.69	0.32	4.60	0.16	4.44	0.00	4.28							1.88	6.16	1.52	7.81	1.30	7.59	0.78	7.07	0.42	6.71	1.12	5.40	0.22	4.50	0.08	4.37								
	05:10			0.29	4.57	0.69	6.86	0.37	6.66	0.08	6.37	0.56	6.84	1.39	5.67	0.31	4.59	0.18	4.44	0.00	4.28							1.87	6.15	1.56	7.85	1.27	7.56	0.95	7.14	0.41	6.70	1.10	5.36	0.22	4.50	0.09	4.37								
3	07:10			0.72	5.00	0.79	7.08	0.35	6.84	0.06	6.35	0.49	6.78	1.36	6.64	0.30	4.58	0.16	4.44	0.00	4.29							1.86	8.14	1.53	7.82	1.27	7.56	0.93	7.22	0.51	6.80	1.08	5.36	0.22	4.50	0.09	4.36								
	05:10			0.84	5.12	0.79	7.08	0.34	6.83	0.04	6.33	0.48	6.75	1.34	5.62	0.29	4.57	0.15	4.43	0.00	4.28					0.09	4.36	1.87	6.15	1.47	7.76	1.26	7.55	0.93	7.22	0.54	6.83	1.08	5.36	0.21	4.49	0.08	4.36								
4	07:10			0.97	5.25	0.95	7.24	0.35	6.84	0.03	6.32	0.41	6.70	1.32	5.80	0.29	4.57	0.15	4.43					0.11	4.38	1.94	6.22	1.49	7.78	1.31	7.60	0.90	7.19	0.53	6.82	1.05	5.33	0.21	4.49	0.08	4.36								
	05:10			1.07	5.35	1.05	7.34	0.33	6.82	0.01	6.30	0.38	6.67	1.31	5.59	0.28	4.56	0.15	4.43					0.12	4.40	1.98	6.26	1.48	7.77	1.35	7.64	0.95	7.14	0.49	6.78	1.04	5.32	0.21	4.49	0.08	4.36								
5	07:10			1.14	5.42	1.01	7.30	0.38	6.87	0.01	6.30	0.33	6.82	1.28	5.56	0.28	4.56	0.14	4.42					0.15	4.43	0.08	6.37	1.47	7.78	1.44	7.73	0.80	7.09	0.45	6.74	1.02	5.30	0.20	4.48	0.07	4.35								
	05:10			1.17	5.45	0.99	7.28	0.41	6.70	0.00	6.28	0.29	6.58	1.27	5.55	0.28	4.56	0.14	4.42					0.16	4.46	0.09	6.38	1.43	7.72	1.44	7.73	0.78	7.07	0.40	6.89	1.01	5.29	0.20	4.48	0.07	4.35								
6	07:10			1.20	5.48	0.99	7.28	0.48	6.77	1.99	6.27	0.26	6.56	1.24	5.52	0.28	4.56	0.14	4.42					0.20	4.48	0.16	6.45	1.54	7.83	1.47	7.76	0.77	7.06	0.36	6.65	0.99	5.27	0.20	4.48	0.07	4.35								
	05:10			1.20	5.48	0.95	7.24	0.52	6.81	1.86	6.26	0.26	6.52	1.22	5.50	0.28	4.56	0.14	4.42					0.20	4.48	0.17	6.46	1.65	7.84	1.46	7.77	0.76	7.05	0.33	6.62	0.97	5.25	0.20	4.48	0.07	4.35								
7	07:10			1.20	5.48	0.91	7.20	0.54	6.83	1.96	6.24	0.19	6.46	1.19	5.47	0.28	4.56	0.13	4.41					0.20	4.48	0.21	6.50	1.57	7.86	1.52	7.81	0.73	7.02	0.28	6.57	0.95	5.23	0.19	4.47	0.06	4.34								
	05:10			1.21	5.49	0.88	7.17	0.54	6.83	1.94	6.22	0.16	6.45	1.18	5.46	0.26	4.56	0.13	4.41					0.16	4.46	0.25	6.54	1.50	7.79	1.47	7.76	0.72	7.01	0.26	6.55	0.94	5.22	0.19	4.47	0.06	4.34								
8	07:10			1.21	5.49	0.92	7.21	0.52	6.81	1.94	6.22	0.11	6.40	1.15	5.43	0.26	4.56	0.13	4.41					0.16	4.44	0.37	6.68	1.41	7.70	1.42	7.71	0.70	6.88	0.21	6.50	0.92	5.20	0.19	4.47	0.06	4.34								
	05:10			1.24	5.52	0.92	7.21	0.50	6.79	1.94	6.22	0.10	6.38	1.13	5.41	0.29	4.56	0.13	4.41					0.13	4.41	0.46	6.75	1.37	7.66	1.36	7.65	0.69	6.88	0.21	6.50	0.90	5.18	0.19	4.47	0.06	4.34								
9	07:10			1.25	5.53	0.99	7.19	0.55	6.84	1.96	6.24	0.05	6.34	1.10	5.38	0.28	4.56	0.18	4.47					0.10	4.38	0.49	6.78	1.34	7.63	1.40	7.69	0.89	6.97	0.17	6.46	0.86	5.14	0.18	4.46	0.05	4.33								
	05:10			1.25	5.53	0.87	7.16	0.53	6.82	1.96	6.24	0.03	6.32	1.09	5.37	0.27	4.55	0.19	4.47					0.07	4.35	0.52	6.81	1.31	7.60	1.37	7.66	0.67	6.96	0.14	6.43	0.85	5.13	0.18	4.46	0.05	4.33								
10	07:10			1.26	5.54	0.83	7.12	0.51	6.80	1.95	6.23	0.01	6.30	1.06	5.34	0.27	4.55	0.17	4.45					0.04	4.32	0.57	6.86	1.31	7.60	1.33	7.62	0.63	6.92	0.10	6.39	0.83	5.11	0.18	4.46	0.05	4.33								
	05:10			1.26	5.54	0.79	7.08	0.49	6.76	1.84	6.22	1.99	6.27	1.05	5.33	0.27	4.55	0.16	4.44					0.04	4.32	0.60	6.89	1.28	7.57	1.29	7.58	0.61	6.90	0.08	6.38	0.81	5.09	0.18	4.46	0.05	4.33								
11	07:10			1.27	5.55	0.76	7.05	0.44	6.73	1.94	6.22	1.94	6.22	1.01	5.29	0.27	4.55	0.15	4.43					0.04	4.32	0.64	6.93	1.24	7.53	1.24	7.53	0.57	6.86	0.05	6.34	0.79	5.07	0.18	4.46	0.05	4.33								
	05:10			1.26	5.54	0.77	7.06	0.42	6.71	1.98	6.26	1.93	6.21	1.01	5.29	0.27	4.55	0.15	4.43					0.04	4.32	0.75	7.04	1.20	7.49	1.20	7.49	0.53	6.82	0.06	6.32	0.77	5.05	0.17	4.45	0.04	4.32								
12	07:10			1.27	5.56	0.84	7.13	0.38	6.67	0.00	6.29	1.90	6.18	0.99	5.27	0.27	4.55	0.14	4.42					0.08	4.37	0.90	7.19	1.13	7.42	1.18	7.47	0.50	6.79	0.00	6.29	0.74	5.02	0.17	4.45	0.04	4.32								
	05:10			1.29	5.57	0.86	7.15	0.36	6.65	0.03	6.32	1.91	6.19	0.97	5.25	0.27	4.55	0.14	4.42					0.20	4.48	1.01	7.30	1.11	7.40	1.16	7.45	0.48	6.77	1.98	6.26	0.73	5.01	0.17	4.45	0.04	4.32								
13	07:10			1.57	5.85	0.91	7.20	0.31	6.60	0.06	6.35	1.90	6.18	0.94	5.22	0.26	4.54	0.14	4.42					0.84	4.92	1.04	7.33	1.07	7.36	1.14	7.43	0.47	6.76	1.98	6.26	0.71	4.99	0.17	4.45	0.03	4.31								
	05:10			1.59	5.87	0.91	7.20	0.30	6.59	0.08	6.37	1.91	6.19	0.93	5.21	0.26	4.54	0.14	4.42					0.94	5.22	1.00	7.29	1.03	7.32	1.10	7.39	0.46	6.75	1.96	6.24	0.70	4.98	0.17	4.45	0.03	4.31								
14	07:10			2.00	6.28	0.90	7.19	0.29	6.58	0.08	6.38	1.93	6.21	0.90	5.18	0.26	4.54	0.13	4.41					1.39	5.67	0.94	7.23	1.03	7.32	1.07	7.36	0.45	6.74	1.93	6.21	0.67	4.95	0.18	4.44	0.03	4.31								
	05:10			2.00	6.28	0.84	7.13	0.27	6.56	0.10	6.39	1.94	6.22	0.89	5.17	0.25	4.53	0.12	4.40					1.53	5.81	0.91	7.20	1.01	7.30	1.04	7.33	0.45	6.74	1.93	6.21	0.66	4.94	0.18	4.44	0.03	4.31								
15	07:10			0.07	6.36	0.88	7.17	0.27	6.56	0.10	6.38	2.00	6.28	0.87	5.15	0.25	4.53	0.10	4.33	0.06	4.34			1.58	5.86	0.87	7.16	0.99	7.28	1.00	7.29	0.46	6.75	1.92	6.20	0.64	4.92	0.18	4.44	0.03	4.31								
	05:10			0.06	6.35	0.87	7.16	0.26	6.55	0.08	6.38	2.00	6.29	0.86	5.14	0.25	4.53	0.09	4.37	0.05	4.33			1.61	5.89	0.83	7.12	0.97	7.26	0.97	7.26	0.46	6.75	1.80	6.18	0.62	4.90	0.18	4.44	0.02	4.30								
16	07:10			0.07	6.36	0.88	7.17	0.24	6.53	0.08	6.37	1.99	6.26	0.84	5.12	0.25	4.53	0.08	4.36	0.04	4.32			1.78	6.06	0.80	7.09	0.97	7.26	0.93	7.22	0.42	6.71	1.87	6.15	0.60	4.88	0.15	4.43	0.02	4.30								
	05:10			0.06	6.35	0.93	7.22	0.24	6.53	0.07	6.36	1.97	6.25	0.82	5.10	0.25	4.53	0.08	4.36	0.03	4.31			1.80	6.08	0.79	7.08	0.97	7.26	0.90	7.19	0.41	6.70	1.87	6.15	0.59	4.86	0.15	4.43	0.02	4.30								
17	07:10			0.05	6.34	0.91	7.20	0.25	6.54	0.08	6.38	1.94	6.22	0.79	5.07	0.24	4.52	0.07	4.35	0.02	4.30			1.96	6.14	0.77	7.06	0.96	7.25	0.82	7.21	0.37	6.66	1.83	6.11	0.56	4.83	0.15	4.43	0.01	4.28								
	05:10			0.08	6.37	0.99	7.19	0.24	6.53	0.11	6.40	1.94	6.22	0.77	5.05	0.24	4.52	0.07	4.35	0.01	4.28			1.90	6.19	0.76	7.05	0.94	7.23	0.99	7.18	0.35	6.64	1.82	6.10	0.54	4.82	0.15	4.43	0.01	4.29								
18	07:10			0.05	6.34	0.85	7.14	0.20	6.49	0.11	6.40	1.92	6.20	0.74	5.02	0.24	4.52	0.06	4.34	0.00	4.28			2.00	6.28	0.71	7.00	1.00	7.29	0.85	7.14	0.32	6.61	1.79	6.07	0.52	4.80	0.15	4.43										
	05:10			0.05	6.34	0.83	7.12	0.21	6.50	0.10	6.39	1.91	6.19	0.73	5.01	0.23	4.51	0.06	4.34	0.00	4.28			0.10	6.39	0.73	7.02	1.08	7.32	0.83	7.12	0.29	6.58	1.77	6.05	0.51	4.79	0.15	4.43										
19	07:10			0.07	6.36	0.79	7.08	0.20	6.48	0.08	6.37	1.89	6.17	0.70	4.98	0.23	4.51	0.06	4.34	0.00	4.28			0.13	6.42	1.28	7.57	1.17	7.46	0.85	7.14	0.25	6.54	1.74	6.02	0.49	4.77	0.14	4.42										
	05:10			0.05	6.34	0.77	7.06	0.19	6.48	0.06	6.35	1.89	6.17	0.69	4.97	0.23	4.51	0.06	4.34	0.00	4.28			0.14	6.43	1.33	7.62	1.31	7.60	0.84	7.13	0.21	6.50	1.72	6.00	0.47	4.75	0.14	4.42										
20	07:10			0.04	6.33	0.75	7.04	0.17	6.46	0.04	6.33	1.86	6.14	0.67	4.95	0.23	4.51	0.06	4.34			0.14	6.43	1.43	7.72	1.45	7.74	0.88	7.17	0.20	6.49	1.69	5.97	0.45	4.73	0.14	4.42										
	05:10			0.06	6.32	0.75	7.04	0.17	6.46	0.02	6.31	1.85	6.13	0.66	4.94	0.23	4.51	0.05	4.33			0.13	6.42	1.42	7.71	1.55	7.84	0.86	7.15	0.16	6.45	1.67	5.95	0.43	4.71	0.14	4.42										
21	07:10	0.14	4.42	0.02	6.31	0.72	7.01	0.16	6.45	1.99	6.27	1.84	6.12	0.63	4.91	0.22	4.50	0.05	4.33			0.13	6.42	1.37	7.66	1.54	7.83	0.88	7.17	0.17	6.46	1.64	5.92	0.41	4.69	0.14	4.42										
	05:10	0.13	4.41	2.00	6.28	0.72	7.01	0.14	6.43	1.97	6.25	1.84	6.12	0.62	4.90	0.22	4.50	0.05	4.33			0.12	6.41	1.34	7.63	1.66	7.97	0.93	7.22	0.14	6.43	1.62	5.80	0.39	4.67	0.14	4.42										
22	07:10	0.11	4.39	2.00	6.28	0.72	7.01	0.13	6.42	1.94	6.22	1.82	6.10	0.59	4.87	0.22	4.50	0.05	4.33			0.10	6.38	1.33	7.62	1.81	6.10	1.01	7.30	0.10	6.39	1.59	5.87	0.37	4.65	0.13	4.41					0.08	4.36				
	05:10	0.10	4.38	2.00	6.28	0.71	7.00	0.13	6.42	1.92	6.20	1.82	6.10	0.58	4.86	0.22	4.50	0.05	4.33			0.10	6.39	1.29	7.58	1.77	8.06	1.04	7.33	0.08	6.37	1.57	5.85	0.35	4.63	0.13	4.41					0.55	4.83				
23	07:10	0.09	4.36	1.99	6.27	0.76	7.05	0.12	6.41	1.89	6.17	1.80	6.08	0.55	4.83	0.22	4.50	0.05	4.33			0.08	6.37	1.26	7.55	1.73	6.02	1.03	7.32	0.13	6.42	1.54	5.82	0.33	4.61	0.13	4.41					0.81	4.89				
	05:10	0.08	4.36	1.99	6.27	0.79	7.08	0.11	6.40	1.88	6.16	1.78	6.06	0.54	4.82	0.22	4.50	0.05	4.33			0.07	6.36	1.23	7.52	1.70	7.99	0.99	7.28	0.11	6.40	1.52	5.80	0.31	4.59	0.13	4.41					0.89	4.87				
24	07:10	0.07	4.35	1.99	6.27	0.76	7.05	0.16	6.45	1.85	6.13	1.75	6.03	0.52	4.80	0.21	4.49	0.05	4.33			0.05	6.34	1.19	7.48	1.85	7.84	1.04	7.33	0.08	6.37	1.49	5.77	0.30	4.58	0.12	4.40					0.73	5.01				
	05:10	0.07	4.35	0.07	6.36	0.73	7.02	0.22	6.51	1.84	6.12	1.75	6.08	0.51	4.79	0.21	4.48	0.04	4.32			0.04	6.33	1.18	7.47	1.84	7.93	1.02	7.31	0.09	6.36	1.47	5.75	0.30	4.58	0.12	4.40					0.92	5.10				
25	07:10	0.06	4.34	0.48	6.77	0.66	6.95	0.30	6.59	1.92	6.10	1.71	5.99	0.48	4.76	0.21	4.49	0.04	4.32			0.03	6.32	1.15	7.44	1.59	7.89	0.97	7.26	0.04	6.33	1.44	5.72	0.29	4.57	0.12	4.40					0.86	5.14				
	05:10	0.06	4.34	0.57	6.86	0.64	6.83	0.35	6.64	1.92	6.10	1.70	5.99	0.47	4.75	0.21	4.49	0.04	4.32			0.01	6.30	1.13	7.42	1.56	7.95	0.93	7.22	0.03	6.32	1.43	5.71	0.28	4.57	0.12	4.40					0.92	5.20				
26	07:10	0.07	4.35	0.67	6.96	0.60	6.89	0.33	6.62	1.82	6.10	1.69	5.97	0.44	4.72	0.20	4.48	0.08	4.31			1.98	6.26	1.16	7.45	1.54	7.83	0.90	7.19	0.08	6.32	1.40	5.68	0.29	4.56	0.11	4.39					0.95	5.23				
	05:10	0.07	4.35	0.70	6.99	0.58	6.87	0.32	6.61	1.82	6.10	1.67	5.95	0.43	4.71	0.20	4.48	0.08	4.31			1.97	6.25	1.13	7.42	1.52	7.81	0.86	7.15	0.02	6.31	1.33	5.66	0.28	4.55	0.11	4.38					0.98	5.26				
27	07:10	0.05	4.33	0.80	7.09	0.60	6.89	0.30	6.59	1.86	6.14	1.85	5.93	0.43	4.71	0.20	4.48	0.08	4.31			1.84	6.22	1.18	7.45	1.49	7.78	0.92	7.21	0.04	6.36	1.35	5.83	0.27	4.55	0.11	4.39										
	05:10	0.04	4.32	0.84	7.13	0.61	6.90	0.29	6.58	1.92	6.20	1.84	5.92	0.42	4.70	0.20	4.48	0.08	4.31			1.95	6.23	1.15	7.44	1.47	7.76	0.93	7.22	0.06	6.32	1.34	5.82	0.28	4.54	0.11	4.39										
28	07:10	0.04	4.32	0.81	7.10	0.57	6.88	0.26	6.55	1.93	6.21	1.81	5.89	0.41	4.69	0.19	4.47	0.02	4.30			1.91	6.19	1.13	7.42	1.44	7.73	1.00	7.29	0.17	6.46	1.32	5.80	0.25	4.53	0.11	4.39										
	05:10	0.04	4.32	0.77	7.06	0.52	6.81	0.26	6.55	0.05	6.34	1.80	5.88	0.40	4.69	0.19	4.47	0.02	4.30			1.91	6.19	1.11	7.40	1.42	7.71	1.00	7.28	0.19	6.49	1.31	5.59	0.25	4.53	0.11	4.39										
29	07:10	0.04	4.32	0.75	7.04	0.49	6.78	0.24	6.53	0.56	6.85	1.58	5.96	0.39	4.67	0.19	4.47	0.02	4.30			1.88	6.18	1.22	7.51	1.39	7.69	1.00	7.29	0.32	6.61	1.29	5.57	0.24	4.52	0.10	4.38										
	05:10	0.04	4.32	0.75	7.04	0.49	6.78	0.22	6.51	0.72	7.01	1.56	5.84	0.38	4.66	0.19	4.47	0.02	4.30			1.87	6.15	1.19	7.46	1.37	7.68	0.89	7.28	0.37	6.66	1.28	5.56	0.24	4.52	0.10	4.38										
30	07:10	0.04	4.32	0.70	6.99	0.45	6.74	0.20	6.49	0.76	7.07	1.54	5.82	0.36	4.64	0.18	4.46	0.01	4.28			1.85	6.13	1.29	7.58	1.41	7.70	0.93	7.22	0.41	6.70	1.26	6.54	0.23	4.51	0.10	4.38										
	05:10	0.04	4.32	0.70	6.99	0.41	6.70	0.17	6.46	0.77	7.06	1.52	5.80	0.35	4.63	0.18	4.46	0.01	4.29			1.83	6.11	1.31	7.60	1.38	7.67	0.90	7.18	0.41	6.70	1.23	5.51	0.23	4.51	0.10	4.38										
31	07:10	0.02	4.30			0.42	6.71	0.15	6.44			1.49	5.77			0.17	4.45	0.01	4.29			1.87	6.15			1.41	7.70	0.85	7.14			1.19	5.47			0.10	4.38								
	05:10	0.02	4.30			0.40	6.69	0.13	6.42			1.48	5.76			0.17	4.45	0.01	4.29			1.87	6.15			1.36	7.65	0.93	7.12			1.18	5.46			0.10	4.38								

ZERO VALUES: 4.283m H2; 6.293m H1

Project Monitoring Program
SHANIR HAOR FCD PROJECT

Rainfall (mm) at Marala (NERP Station)

DAY	1992								1993												1994				
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1		0.00	14.48	31.50	48.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.32	15.75	47.20	6.90	2.50	41.90	0.00	0.00	0.00	7.62	0.00	88.90	0.00
2		0.00	11.43	71.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.00	6.90	34.30	76.20	0.00	0.00	0.00	7.11	0.00	4.32	0.00
3		0.00	218.44	17.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.16	6.35	15.70	14.00	169.40	41.40	0.00	0.00	0.00	7.62	0.00	0.00	0.00
4		0.00	172.72	118.59	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00	132.08	43.69	12.70	2.00	90.90	0.00	0.00	0.00	0.00	0.00	0.00	5.08	0.00
5		0.00	90.68	15.75	59.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.89	10.92	40.60	64.80	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.34
6		0.00	52.32	171.20	19.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.86	134.37	53.30	53.80	18.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7		0.00	2.79	78.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.94	41.15	96.00	1.50	14.50	0.00	0.00	0.00	0.00	0.00	0.00	21.59	0.76
8		5.08	46.23	18.29	43.69	0.00	0.00	0.00	8.60	0.00	0.00	0.00	15.24	139.70	0.00	26.20	2.50	0.00	0.00	0.00	0.00	0.00	0.00	9.14	0.00
9		0.00	3.81	148.84	74.68	0.00	0.00	0.00	31.50	0.00	0.00	0.00	0.00	84.07	20.80	147.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.38
10		0.00	7.62	2.29	9.91	0.00	0.00	0.00	2.30	0.00	0.00	18.54	20.32	68.07	36.80	142.20	0.00	0.00	0.00	0.00	0.00	7.87	0.00	0.00	0.00
11		2.54	5.33	0.00	9.65	0.00	0.00	0.00	0.00	0.00	0.00	58.93	4.32	62.48	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.38
12		20.32	50.29	0.00	21.08	13.97	0.00	0.00	0.00	0.00	0.00	57.15	76.20	169.67	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.57
13		71.12	55.37	0.00	20.83	125.22	0.00	0.00	0.00	0.00	0.00	2.03	33.27	4.32	0.00	0.00	10.70	87.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14		72.64	56.64	4.06	13.46	68.58	0.00	0.00	0.00	5.30	0.00	0.00	3.05	0.00	28.20	0.00	0.00	6.10	0.00	0.00	0.00	0.00	2.79	0.00	8.89
15		38.10	9.65	61.72	0.51	119.38	0.00	0.00	0.00	0.00	46.23	0.00	0.00	0.00	4.30	2.00	27.20	88.40	5.30	0.00	0.00	0.00	9.65	0.00	21.59
16		0.00	57.40	5.08	4.32	2.54	0.00	0.00	0.00	0.00	0.00	3.81	148.84	57.15	29.50	0.00	34.80	0.00	0.00	0.00	2.00	0.00	9.40	0.00	35.56
17		0.00	63.50	43.18	90.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.19	20.32	59.70	27.40	7.60	0.00	0.00	0.00	4.60	0.00	0.00	0.00	1.27
18		5.33	1.52	0.51	0.00	0.00	0.00	0.00	0.00	8.40	0.00	0.00	56.39	35.56	160.00	51.60	3.00	0.00	0.00	0.00	0.00	0.00	19.30	0.00	44.45
19		31.50	2.54	22.86	0.00	0.00	0.00	0.00	0.00	20.10	0.00	0.00	0.00	167.64	171.50	9.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20		10.41	8.64	0.51	0.00	0.00	0.00	0.00	0.00	0.00	3.81	0.00	2.03	166.37	160.00	47.20	0.00	0.00	0.00	0.00	0.00	0.00	23.88	25.40	0.00
21		12.70	16.76	5.33	0.00	34.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.54	162.60	7.10	0.00	0.00	0.00	0.00	0.00	0.00	38.86	0.00	0.00
22		4.83	34.29	2.54	0.00	4.32	0.00	0.00	0.00	18.30	0.00	0.00	0.00	50.80	134.10	94.00	0.00	0.00	0.00	0.00	0.00	0.00	18.54	0.00	0.00	0.00
23		4.06	167.64	22.86	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0	0.00	0.76	15.50	61.00	71.90	0.00	0.00	0.00	0.00	7.11	0.00	0.00	153.67
24		14.22	25.40	47.24	0.51	0.00	1.27	0.00	0.00	0.00	0.00	1.02	0.00	1.27	7.60	56.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.23	0.00
25		207.26	0.00	148.59	25.15	0.00	0.00	0.00	0.00	0.00	0.00	87.88	0.00	7.37	2.50	7.40	19.10	0.00	0.00	0.00	0.00	0.00	21.08	47.50	76.96
26		102.87	6.35	41.91	11.43	0.00	0.00	0.00	0.00	0.00	10.41	9.91	0.00	16.26	0.00	0.00	80.50	0.00	0.00	0.00	0.00	0.00	36.58	6.60	21.84
27		115.32	7.87	20.83	45.21	0.00	0.00	0.00	0.00	0.00	37.59	1.52	11.43	23.62	1.00	147.30	74.70	0.00	0.00	0.00	0.00	0.00	88.90	0.00	0.00
28		0.76	15.49	2.54	34.29	0.00	0.00	0.00	0.00	0.00	0.00	1.52	1.52	66.04	0.00	86.40	142.20	0.00	0.00	0.00	0.00	0.00	60.20	0.00	ND
29		91.95	4.06	0.00	255.27	0.00	0.00	0.00	0.00		0.00	0.00	0.00	109.47	0.00	77.00	120.70	0.00	0.00	0.00	0.00		0.00	0.00	ND
30		82.80	0.00	0.00	12.45	0.00	0.00	0.00	0.00		0.00	0.00	7.11	160.78	79.20	0.00	4.10	0.00	0.00	0.00	0.00		0.00	10.67	ND
31			34.54	17.78		0.00		0.00	0.00		0.00		14.73		17.00	2.50		0.00		0.00	7.90		3.81		ND
SUM		893.83	1243.84	1120.14	799.59	369.32	1.27	0.00	42.40	52.90	98.04	242.32	660.91	1666.49	1401.80	1145.40	930.60	341.60	5.30	0.00	14.50	55.88	314.45	249.43	423.67

Project Monitoring Program
SHANIR HAOR FCD PROJECT

Rainfall (mm) at Tahirpur (NERP Station)

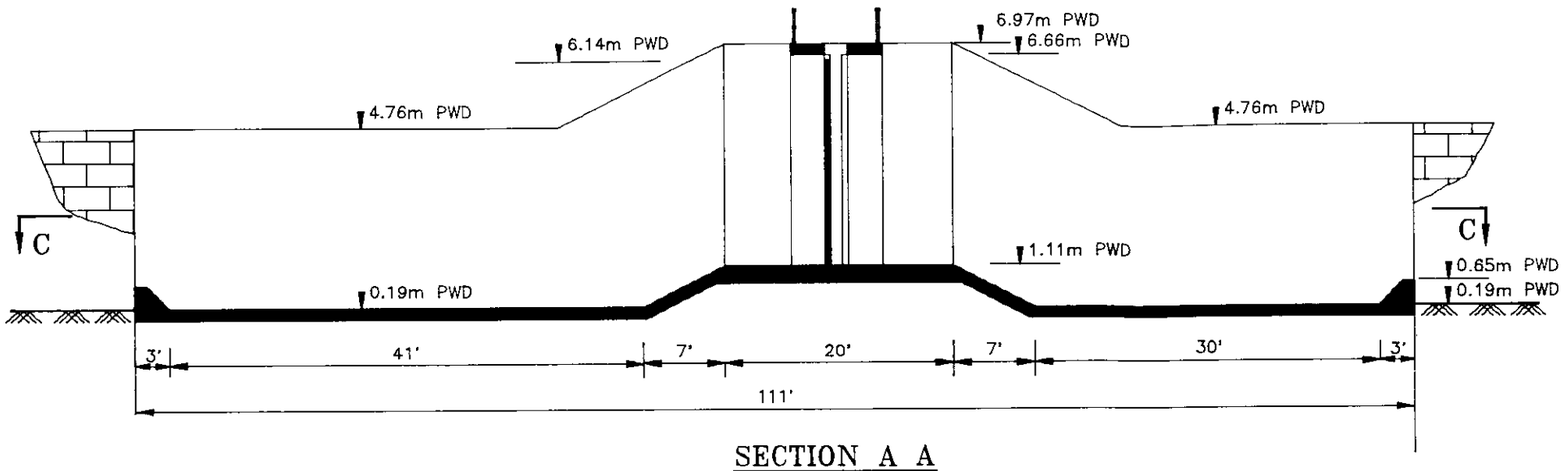
DAY	1992								1993												1994				
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1		0.00	35.56	20.83	33.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.60	40.60	0.00	25.40	1.00	0.00	0.00	0.00	2.00	0.00	53.34	0.00
2		0.00	43.69	41.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.00	43.20	27.40	30.00	63.50	0.00	0.00	0.00	1.00	0.00	5.08	0.00
3		0.00	150.88	6.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	14.50	15.20	5.10	104.10	116.30	0.00	0.00	0.00	8.90	0.00	0.00	0.00
4		0.00	196.85	111.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	106.70	49.50	29.00	2.30	10.20	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00
5		0.00	85.85	56.90	22.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.00	6.10	30.70	83.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.34
6		0.00	53.09	150.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.40	78.70	48.30	57.20	10.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.18
7		0.00	4.32	64.77	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	34.30	38.90	132.10	2.80	2.50	0.00	0.00	0.00	0.00	0.00	0.00	11.43	0.00
8		29.46	30.99	17.78	67.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	116.80	0.00	45.70	2.00	0.00	0.00	0.00	0.00	0.00	0.00	58.93	0.00
9		0.00	2.03	137.16	72.90	0.00	0.00	0.00	3.81	0.00	0.00	1.02	0.00	50.80	45.70	111.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.14
10		0.00	11.43	8.38	71.37	0.00	0.00	0.00	44.45	0.00	0.00	14.73	9.90	59.40	29.00	48.30	3.30	0.00	0.00	0.00	0.00	9.40	0.00	0.00	0.00
11		0.00	4.32	0.00	11.68	0.00	0.00	0.00	3.81	0.00	0.00	34.04	15.50	33.80	1.00	9.10	7.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12		50.04	46.23	0.00	17.27	6.35	0.00	0.00	0.00	0.00	0.00	48.01	50.80	200.70	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13		33.78	40.64	0.00	26.42	51.31	0.00	0.00	0.00	0.00	0.00	6.60	40.60	0.00	0.00	0.00	17.80	17.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14		48.26	34.54	8.13	20.32	86.36	0.00	0.00	0.00	6.35	0.00	0.00	2.00	0.00	22.40	2.00	2.50	14.00	0.00	0.00	0.00	0.00	0.00	0.00	21.59
15		37.08	10.67	46.74	0.00	107.19	0.00	0.00	0.00	28.19	11.43	4.57	0.00	0.00	0.50	2.30	6.40	15.50	2.00	0.00	0.00	0.00	1.30	0.00	14.00	0.00	11.68
16		0.00	38.61	7.87	22.86	1.02	0.00	0.00	0.00	0.00	0.00	0.00	124.50	22.90	22.10	5.10	2.00	0.00	0.00	0.00	0.00	0.00	3.80	0.00	0.00	0.00	0.00
17		0.00	47.50	13.72	97.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.80	11.70	82.60	26.70	0.00	0.00	0.00	0.00	0.00	0.00	31.00	0.00	80.52
18		0.00	0.00	3.30	0.00	0.00	0.00	0.00	0.00	17.78	0.00	0.00	35.60	23.40	92.70	11.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.27	0.00
19		31.50	3.56	39.37	0.00	0.00	0.00	0.00	0.00	7.62	0.00	0.00	0.00	152.40	289.60	8.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.70	1.02	0.00
20		3.05	14.99	4.83	0.00	0.00	0.00	0.00	0.00	0.00	4.06	0.00	0.00	101.60	198.10	48.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.80	32.51	0.00
21		54.61	9.91	10.41	0.00	3.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.40	108.00	7.60	0.00	0.00	0.00	0.00	0.00	0.00	17.30	0.00	0.00	0.00
22		0.00	54.36	3.30	0.00	7.11	0.00	0.00	0.00	27.94	5.33	0.00	0.00	47.80	166.40	87.60	0.00	0.00	0.00	0.00	0.00	0.00	3.80	0.00	0.00	279.40
23		12.70	179.32	0.00	0.00	0.00	0.51	0.00	0.00	1.02	0.00	0.00	0.00	0.00	17.00	49.50	60.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24		18.29	61.72	58.42	1.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.80	0.00	0.00	0.00	0.00	0.00	0.00	20.30	9.14	7.62
25		229.62	0.00	69.85	56.90	0.00	0.00	0.00	0.00	0.00	17.78	88.90	0.00	0.00	7.60	13.20	18.30	0.00	0.00	0.00	0.00	0.00	29.20	48.26	17.78
26		174.50	7.87	20.32	6.86	0.00	0.00	0.00	0.00	0.00	11.18	10.16	0.00	16.50	0.00	9.70	50.80	0.00	0.00	0.00	0.00	0.00	101.60	6.60	1.02
27		157.99	5.59	20.32	60.20	0.00	0.00	0.00	0.00	0.00	37.08	0.00	2.50	27.40	0.00	139.70	62.50	0.00	0.00	0.00	0.00	0.00	27.20	0.00	ND
28		3.30	12.95	2.03	40.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	38.90	0.00	193.00	157.50	0.00	0.00	0.00	0.00		0.00	0.00	ND
29		85.09	12.95	0.00	234.95	0.00	0.00	0.00	0.00		0.00	10.16	0.00	70.60	0.00	63.50	96.50	0.00	0.00	0.00	0.00		0.00	0.00	ND
30		87.63	0.00	0.00	29.97	0.00	0.00	0.00	0.00		0.00	0.00	0.00	252.70	99.80	2.00	3.60	0.00	0.00	0.00	2.80		0.00	0.00	ND
31			19.05	10.16		0.00		0.00	0.00		0.00		82.60		21.60	0.00		0.00		0.00					
SUM		1056.89	1219.45	934.97	895.60	262.38	0.51	0.00	52.07	88.90	86.87	218.19	600.00	1549.10	1543.70	1113.20	673.40	228.10	2.00	0.00	7.90	42.40	283.80	228.35	461.26

Project Monitoring Program
SHANIR HAOR FCD PROJECT

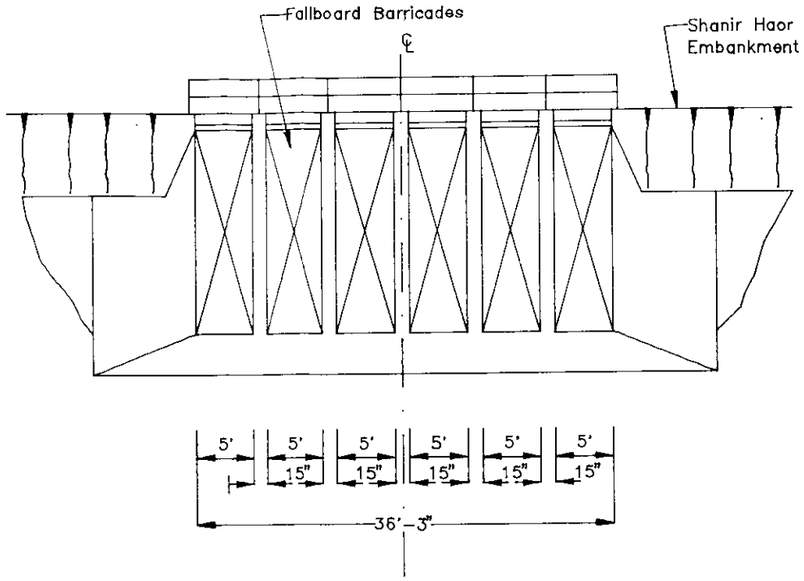
Adjusted Pan Evaporation (mm) at Sunamganj (Stn. No. E37)

Day	1992												1993												1994				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	3.05	3.74	2.54	4.06	5.08	4.92	6.36	5.80	5.84	3.05	4.06	3.05	2.54	3.74	2.54	4.57	7.60	4.68	7.62	6.76	6.66	2.95	4.06	3.05	4.06	1.94	4.06	7.62	4.06
2	2.54	3.05	2.54	3.56	3.68	4.06	6.28	6.94	5.08	4.06	4.57	2.54	2.54	2.03	3.05	5.08	4.06	5.99	3.08	3.86	3.78	7.62	3.05	2.54	3.56	2.90	3.56	6.44	5.08
3	3.05	3.05	3.05	4.06	7.62	5.38	4.98	4.86	6.10	4.57	3.56	2.54	3.05	2.03	3.05	5.08	3.74	1.87	1.79	2.38	7.62	6.96	3.56	2.54	3.56	1.95	4.57	3.05	5.08
4	2.54	2.54	3.56	4.57	7.62	5.08	5.68	6.44	2.00	3.56	4.06	3.05	3.05	2.54	4.06	4.06	7.62	4.78	3.58	3.90	1.95	4.44	3.05	3.05	3.05	3.05	4.06	4.38	1.96
5	3.56	2.54	3.05	4.57	5.71	5.08	7.62	7.62	4.84	4.06	5.08	3.05	2.54	2.54	4.06	4.57	6.80	1.84	7.62	4.22	4.06	4.06	3.56	3.05	3.05	3.56	3.05	3.56	1.90
6	3.05	3.05	4.06	4.06	4.06	6.10	5.70	5.32	6.06	4.06	4.57	2.54	2.54	3.05	3.05	4.57	5.66	3.80	7.22	7.62	4.84	5.08	3.56	3.56	3.56	3.56	3.56	7.28	2.20
7	2.54	3.05	4.06	5.08	2.00	5.08	5.78	5.86	5.08	5.08	4.06	3.05	2.03	3.05	3.56	5.08	6.90	7.36	6.26	7.62	6.00	4.06	3.05	3.56	3.05	3.05	4.06	2.79	0.94
8	2.54	5.00	3.56	5.08	4.57	7.32	5.14	5.93	6.42	5.08	4.06	3.56	3.94	2.54	3.56	5.08	4.06	5.75	1.84	7.62	6.92	4.57	2.54	4.06	3.56	3.05	4.06	4.76	1.43
9	3.05	3.05	4.57	4.57	4.06	3.00	4.82	5.30	4.66	6.10	3.56	3.56	5.14	2.54	4.06	7.00	3.56	5.54	2.92	7.62	3.00	5.08	3.05	4.06	4.06	3.56	3.56	4.06	2.14
10	2.54	3.05	4.57	5.08	7.62	3.90	5.44	2.54	7.30	5.59	4.06	3.05	2.46	2.54	4.06	6.30	7.62	3.80	4.14	4.76	7.62	4.57	3.05	3.56	4.06	3.92	3.56	4.06	4.06
11	2.54	3.56	4.06	4.57	4.00	3.54	4.38	5.08	3.66	5.08	3.05	3.05	2.54	2.03	5.08	7.62	3.24	3.88	4.06	4.06	5.08	5.08	3.56	3.56	3.56	3.05	3.05	3.56	0.95
12	2.54	4.06	4.06	5.08	5.08	5.26	7.36	5.08	7.62	4.57	3.56	2.54	2.54	3.05	4.57	5.74	7.22	6.98	1.95	5.08	6.10	4.06	4.06	3.05	3.56	3.05	4.06	3.56	0.94
13	3.05	4.06	4.57	6.10	5.08	7.62	7.62	6.10	6.66	6.88	4.06	2.54	2.03	3.05	0.51	2.00	7.62	0.92	5.08	2.46	7.62	4.92	3.56	3.05	4.06	2.54	4.06	4.06	4.06
14	2.54	3.05	3.56	6.10	6.10	6.48	5.76	6.58	3.72	7.62	3.05	3.05	2.03	3.14	4.06	4.06	1.84	4.06	7.62	3.56	5.46	3.00	3.56	2.54	4.06	2.54	2.95	4.57	1.74
15	2.03	3.05	4.06	5.08	5.90	7.46	7.62	6.30	2.95	6.04	3.56	3.05	3.05	7.62	3.92	5.08	4.06	5.08	5.08	4.84	7.62	5.00	4.06	2.54	3.05	3.05	1.46	4.06	3.04
16	2.03	3.05	4.06	6.10	4.38	5.08	7.62	1.95	4.06	3.05	4.06	3.56	2.54	2.00	3.56	2.92	6.34	0.90	7.22	4.87	7.62	3.05	3.05	2.54	2.00	3.05	4.68	4.57	1.92
17	2.54	3.56	4.57	6.10	7.62	6.10	7.62	6.50	7.54	3.05	4.06	3.56	2.54	2.03	4.06	4.06	7.62	3.14	7.62	7.62	7.62	3.56	3.05	3.05	0.94	4.06	1.87	3.56	2.22
18	2.54	3.56	4.57	6.60	7.62	5.90	3.89	7.62	2.54	4.06	3.56	2.54	3.05	3.90	4.06	5.08	7.62	2.78	7.62	1.95	4.06	4.06	3.56	3.05	3.05	4.06	1.84	3.05	1.10
19	2.54	4.06	7.62	7.62	6.84	2.46	2.92	3.05	4.06	3.05	3.05	2.54	3.05	4.84	4.57	5.08	3.05	3.62	7.44	3.00	5.08	4.06	3.56	3.05	3.05	3.56	3.00	5.66	5.08
20	2.03	4.06	7.62	7.22	5.08	7.38	7.62	4.06	5.08	3.05	3.05	3.05	2.54	2.54	5.94	4.57	2.00	3.34	7.62	7.62	6.92	4.57	3.05	2.54	3.56	3.56	1.70	3.76	5.08
21	2.03	3.05	3.82	5.00	7.62	7.62	7.62	7.62	4.06	7.30	3.56	3.05	3.05	3.05	4.06	4.06	3.56	3.05	7.62	7.30	3.05	5.08	3.05	2.54	4.06	4.06	4.36	5.60	4.06
22	2.03	1.87	2.00	7.62	4.06	5.08	7.62	6.76	4.57	2.03	4.06	3.05	3.05	3.66	2.46	4.57	4.06	6.50	2.96	7.62	4.06	5.08	3.56	3.05	4.06	2.87	3.05	2.76	4.57
23	2.54	3.56	6.70	3.82	5.08	5.00	6.76	3.05	4.57	2.54	4.06	2.03	2.54	[illegible]5	7.30	5.08	4.57	3.05	4.76	4.84	5.76	4.06	4.06	3.05	3.56	4.76	1.46	3.05	3.64
24	2.03	3.05	3.05	3.05	5.59	7.55	7.62	1.46	4.06	3.05	3.05	2.03	2.54	2.54	2.00	4.57	4.06	6.76	1.90	5.14	4.06	4.06	3.05	3.05	3.56	3.05	2.00	1.67	1.12
25	2.03	3.05	1.94	4.06	5.08	7.53	4.06	5.30	3.68	3.05	1.52	3.05	2.03	2.54	1.95	7.62	5.08	4.00	2.38	7.62	5.97	3.56	3.05	3.56	4.06	3.05	1.90	2.78	3.80
26	2.03	3.56	4.57	4.57	5.90	4.80	6.82	4.84	2.54	4.06	3.05	3.05	2.03	3.05	3.92	3.84	2.00	7.22	3.05	4.06	7.62	3.56	3.56	3.56	4.06	4.06	4.92	2.95	1.84
27	2.54	3.56	4.57	1.95	5.08	7.48	4.00	7.01	6.88	4.06	2.54	2.54	2.54	3.05	7.62	1.94	4.06	6.26	4.06	4.18	5.30	4.06	3.56	3.05	3.05	4.06	3.80	5.25	2.00
28	3.05	3.05	4.06	4.86	1.50	3.05	4.84	5.86	5.62	4.06	3.05	2.54	2.54	3.05	3.05	1.90	6.74	2.46	2.95	5.44	7.62	3.56	3.05	3.05	3.05	3.56	6.98	4.06	1.04
29	3.05	1.95	4.05	4.57	1.00	2.00	2.46	4.06	5.04	3.05	2.54	2.03	3.05		4.06	2.38	3.56	5.03	5.90	4.74	7.28	4.06	3.05	3.05	3.56		3.05	4.57	1.60
30	2.54		3.56	4.06	4.06	7.62	3.05	5.08	3.92	3.05	2.54	2.03	3.05		4.06	4.06	4.06	5.70	7.62	2.84	7.62	3.56	2.54	3.05	3.05		2.79	4.57	1.74
31	2.54		4.57		5.08		7.62	1.78		3.56		2.03	2.54		4.57		2.22		7.62	2.92		3.56		3.05	3.38		3.56		2.00
SUM	79.25	94.86	127.23	148.84	159.79	164.93	182.68	161.76	146.24	131.47	106.68	86.90	84.69	84.78	120.45	137.66	152.22	130.16	158.22	158.12	173.97	134.97	100.08	96.01	105.88	92.51	104.64	125.90	82.40

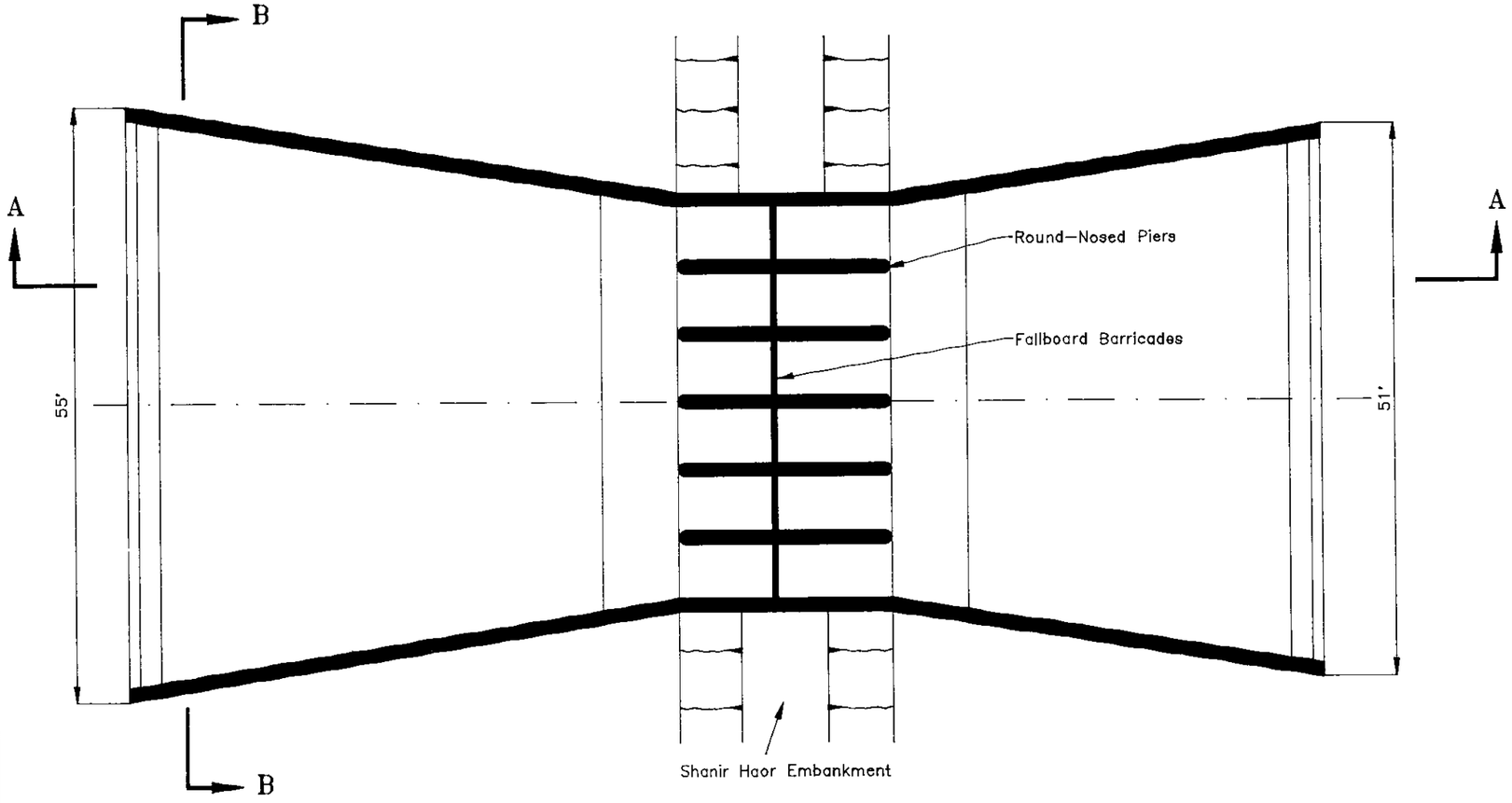
Note: Missing values found by interpolation between adjacent values
All values >7.62mm reduced to 7.62mm



SECTION A A



ELEVATION B B



SECTION C C

FILE: NERP-846.DWG

Northeast Regional Project	
Shanir Haor Project	
Bogiani Regulator (As Built)	
Prepared by: Michael E. Ibbitt	June 1994
Computer Drafting by: Mamun	AutoCAD Drawing

APPENDIX B

RIVER MORPHOLOGY AND SEDIMENT DATA

APPENDIX B : RIVER MORPHOLOGY AND SEDIMENT DATA

INDEX

B.1 NERP SURVEYS IN SHANIR HAOR

NERP has made several preliminary section line surveys through Shanir Haor in order to determine the sedimentation pattern over the past 30 years. The map in figure 1 gives the location of the section lines. The sections are given in figures 2 - 7 and described below. A comparison is made between the elevations from the 1963, 4" to the mile maps and those surveyed by NERP.

NERP Survey Method

All section lines were surveyed using an echo-sounder and a GPS. The echo sounder records water depth, which is easily translated to haor floor elevation when the water elevation is known. Preliminary water levels at Marala have been used for the calculations; final elevation are still not available as the gauge has not been tied in to the second order levelling program. The GPS is used to record the path (X and Y co-ordinates) of the boat. This same path or section line is then overlaid on the 4" to a mile map, and the 1963 elevation are extracted. The 1993 and 1963 sections are then plotted together and compared. Unfortunately the older maps do not give any elevations for the permanently flooded *beel* areas. For this reason some of the 1963 section lines are incomplete (see sections A, B, and S6).

Section Lines

Section Line A (26 November 1992): Most of the 1963 data is missing for this section. Where it is available (near km 1.5 and 3.0) it would suggest that there is practically no aggradation. The significant feature of this is the end point which drops to below -12 m PWD. This is a major scour hole that has developed at Ahmokkhali where the embankment is cut every year.

Section Line B (30 June 1993): Over 2.5 km of 1963 data is missing in this section as well. Generally there seems to be about 1 - 1.5 m of aggradation in the northern portion of the hoar (km 3.5 - 6.0)

Section Line C (30 June 1993): The centre of this section line (which is the centre of the haor) shows no change since 1963. Again 1.0 - 1.5 m of aggradation occurs in most other places with some points (see km 6) having 2 m of aggradation. Beyond km 7 degradation appears to have taken place.

Section Line D (05 October 1993): Generally about 1.0 m of aggradation. The unusual profile at km 1.0 is an area close to the village and can not be taken as representative of the area.

Section Line S1 (06 October 1993): The 1993 survey is incomplete due to equipment difficulty. Degradation seems to have occurred at the 2.5 km mark (similar to C)

Section Line S2 (06 October 1993): Degradation or zero aggradation appears to have occurred in the first and last half kilometres of this section line. The middle one kilometre shows aggradation of a meter or more.

Section Line S3 (06 October 1993): This section begins where S2 leaves off - with no aggradation - but soon levels off to about 0.5 m of aggradation for most of the 2 km.

Section Line S4 (06 October 1993): This section shows mostly aggradation of 0.5 to 1.0 m. Only the last 1 km contains some strange land profiles. It also shows that the lowest portion has degraded slightly since 1963.

Section Line S5 (06 October 1993): This section shows slight aggradation in the middle, higher portion, and no aggradation, or possible degradation in the lower portions.

Section Line S6 (06 October 1993): This section shows slight degradation for the whole length. This sections line runs through the deepest part of the haor. As pointed out above several km of 1963 data are missing because the permanently flooded area were not surveyed.

Section Line S7 (06 October 1993): Section S7 is located along the east side of Marala village and the embankment of the Baulai River. It shows that there has been 1.5 m of degradation. But this is deceptive because the land in this area drops steeply from the village platform to the haor bed. It is possible that this was previously a portion of the village platform but has been eroded and the village has move since 1963. This section is not considered representative of the whole area.

Summary

The section line data seems to indicate that a lower portions of the haor have experienced little, or no aggradation at all. Section lines A, B, S4, S5 and S6 all show that practically no aggradation has taken place in at elevations below 3 m PWD. The general trend seems to be that the lower elevation have less aggradation and some portions show signs of degradation.

Most areas over 3 m PWD show signs of aggradation. These areas show between 0.5 and 2.0 m higher bed elevations form 1963. The areas of highest aggradation are on the north and east of the haor. This makes sense since these points are closest to the mouth of the Jadukata which carries the highest concentration of sediments into the area.

However there is an anomaly in the north east portion of the haor which shows signs of degradation. The end portion of sections lines C and S1, and the beginning portion of S2 all indicate that this area has degraded since 1963. The reasons for this are not very clear. It is possible however that this area is a spill channel from the Rakti River into the haor. The flows here would be rather high and would not allow the sediment to settle out until further into the haor.

As an approximation as to the total volume of sediment that has entered into Shanir Haor since 1963 we make 2 assumptions. First that the area below 3.0 m PWD (3,392 ha) has no sediment deposited on it. Second that the rest of the haor has 1.0 m (this would be on the high side) of

sediment deposit. The total area of the haor is 7,761 ha; therefore the area with sediment is 4,369 ha (7,761 - 3,392) and the total volume is 43.69 million cubic meters of sediment.

B.2 CROSS SECTIONS OF RIVERS AROUND SHANIR HAOR

NERP surveyed 12 cross sections of the rivers around Shanir Haor. The section were first established in June of 1992 and then re-surveyed in November of 1992 and June 1993. The location plan of the cross sections is given in figure 8 and the cross sections are given in figures 9 - 11.

Most of the sections showed no change or slight degradation over the one year. Only cross section 02 and 05 showed signs of aggradation. Section 02 is where the Baula splits from the Jadukata. This section has been silting up over several years. During the 1993 dry season it was possible to walk across the river at this point. At section 05 the floodplain shows significant siltation. This can be expected since the river widens out, the flows slows and drops the sediment load. Cross section 11 has an unexplained shift and is considered erroneous.

B.3 REMOVAL OF SEDIMENT FROM THE JADUKATA RIVER

This is a summary data collected from NERP's sediment team, fisheries team and the social anthropology team.

By all accounts there are 5,000 to 6,000 Barki boats that work on the Jadukata river. These are small boats; approximate dimensions are: 5 m long x 1.5 m wide x 0.5 m deep. The carrying capacity of these boats is said to be 30 to 35 cft. There are usually 2 persons per boat.

The standard mode of operation for these Barki boats is to move up the Jadukata river towards the border. When they reach the "good" deposits the boatmen "dive" for sand, or shingles, or stone (we observed 3 distinct grades of sediment). According to the book Country boats of Bangladesh it is easier to dive from a boat for sand then it is to remove sand from the bank because the boat is closer. After the boats are filled they return down to Fazilpur to sell the load. The price seems to vary, but some standard numbers that are passed around are; 125 Tk. per boat load of sand and 150 Tk. per boat load of stone. The prices drop during the dry season to 90 Tk. per boat load. We observed that generally there were more Barki boats with sand than stone, and that, in terms of volume, those carrying sand appeared to have more.

This activity is said to go on year-round, though it's intensity decreases during the dry season. In the monsoon season the barki boats are able to unload directly into the larger cargo boats and vessels which carry the sand (shingles or stone) down to Durlarpur, or sometimes all the way to Dhaka. In the Dry season the sand is bought by middle men who store it on the banks of the river at Fazilpur until the next monsoon season when the larger vessels are able to pass through the Rakti or Nandia Gang (also referred to as the Abbua) rivers. The middle man is said to make 0.20 Tk./cft.

It appears that anyone can collect sediment from the Jadukata river by Barki boat, however all the sediment must be sold to one of the "contractors" at Fazilpur. (There appears to be no controls at the quarry end of the operation.) There is an "Association" of "contractors", which

has about 100 members. This year the "Association" paid a lease fee of 20 lakh Taka to the Ministry of Land. In return, the "Association" is allowed to collect a "tax" from it's members, the "contractors". The "tax" rate is 0.15 Tk./cft for sand, and 0.50 Tk./cft for stone. Last year the lease fee was only 9.7 lakh Taka. It is not clear how long the government has been collecting lease fees. But one man was interviewed (by the Soc A. Team) who had collecting sand from Fazilpur for the last 30 years.

From Fazilpur the sand, shingle, and stone is moved south on larger vessels. There are said to be 50 cargo boats and barges (capacity 7000 - 10000 cft = 150 - 200 tons), as well as hundreds of country boats (capacity 500 - 700 cft) moving the sediment from Fazilpur to points south. During the dry season these larger vessels are not able to come all the way up to Fazilpur. Their normal routes of travel are via the Rakti river or the Nandia Gang river. There have been complaints of these two rivers silting up over the last few years. According to the Social Anthropology report the critical areas in these rivers appear to be at Beheli on the Nandia Gang, and from Durlarpur to Niamotpur on the Rakti river. This seems to be in general agreement with our own river depth observations using the sonar, though some detailed discrepancies exist (see memo 9 Dec. 1992).

CALCULATIONS

Assume
- 5,000 Barki Boats(BB) per day
- 65% of the BB are carrying sand
- 35% of the BB are carrying stone
- carrying capacities are 30 cft & 25 cft for sand & stone
- 26 working days per month

Quantities of sediment:

	SAND	STONE
	5,000 X .65 = 3250 BB/day	5,000 X .35 = 1750 BB/day
	x capacity 30 cft = 97,500 cft/day	x capacity 25 cft = 43,750 cft/day
metric	= 2,750 cu.m/day	= 1,250 cu.m/day
	x 26 days	x 26 days
	71,500 cu.m/month	32,500 cu.m/month

TOTAL = 104,000 cu.m/month sediment removed

Income:

3,250 BB/day	1,750 BB/day
x 125 Tk./BB	x 150 Tk./BB
= 406,250 Tk./day	= 262,500 Tk./day

Total = 669,750 Tk./day
x 26 days
TOTAL = 17,387,500 Tk./month in the local economy

Tax:

97,500 cft/day	43,750 cft/day
x 0.15 Tk./cft	x 0.50 Tk./cft
= 14,625 Tk./day	= 21,875 Tk./day

TOTAL = 36,500 Tk./day

2,000,000 Tk. lease fee
/ 36,500 Tk./day
= 54.79 or 55 day to recover the lease fee in taxes.

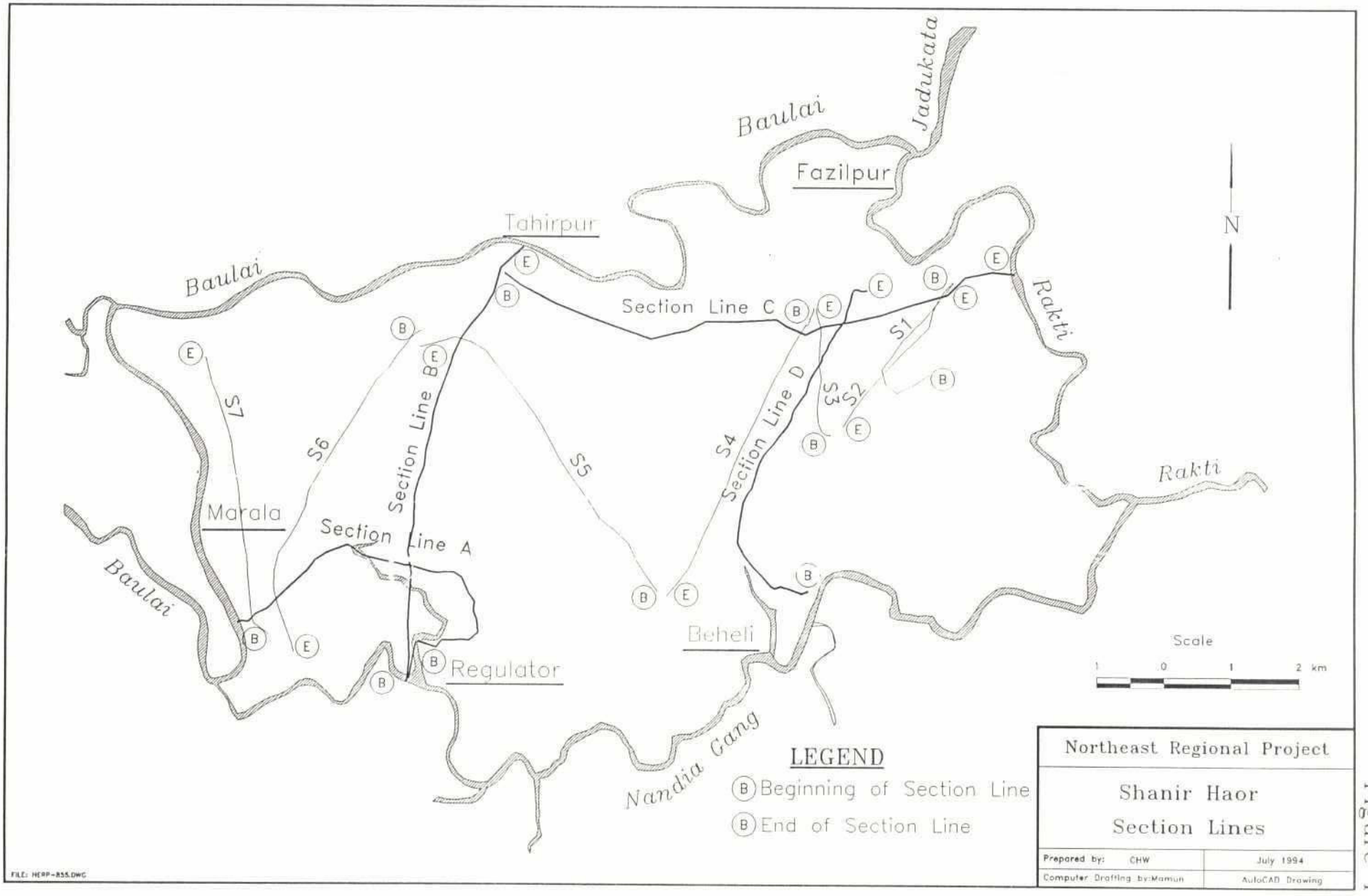
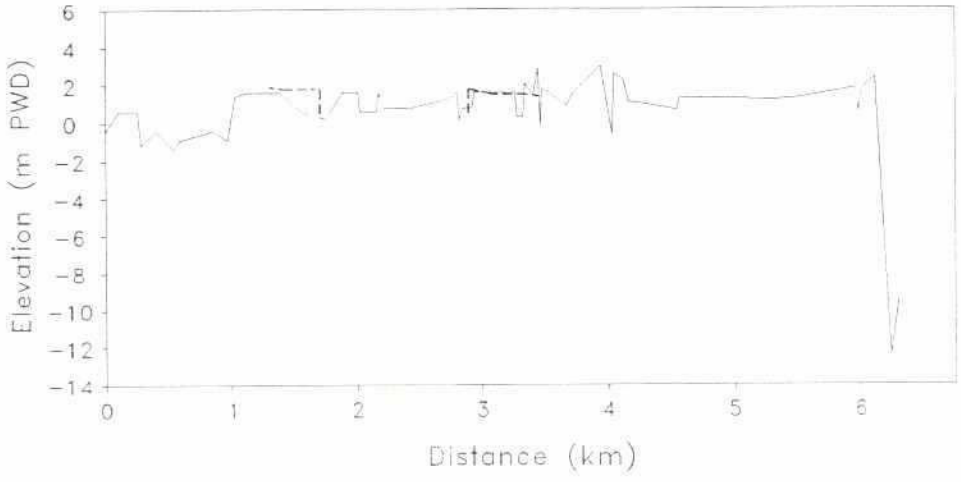
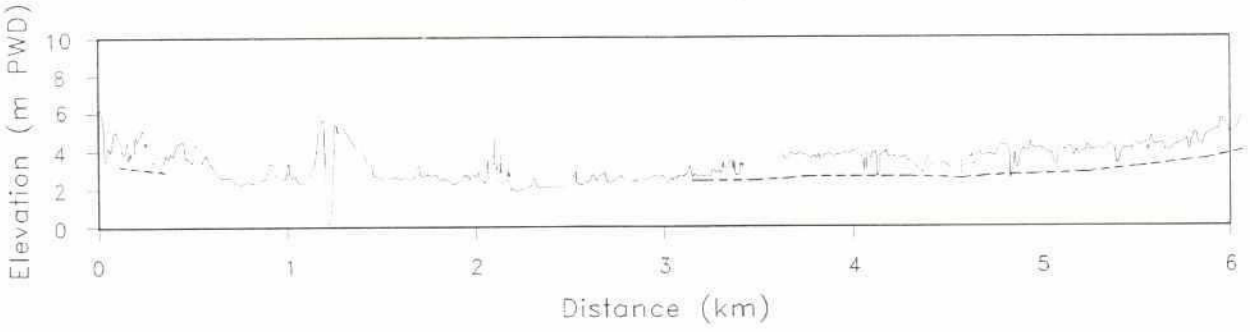

Baulai
Jadukata
Fazilpur
Tahirpur
Baulai
Section Line C
S1
Rakti
N
S7
S6
Section Line B
S5
S4
Section Line D
S3
S2
Rakti
Marala
Section Line A
Baulai
Beheli
Regulator
Nandia Gang
Scale
1 0 1 2 km
LEGEND
(B) Beginning of Section Line
(E) End of Section Line
Northeast Regional Project
Shanir Haor
Section Lines
Prepared by: CHW
July 1994
Computer Drafting by: Mamun
AutoCAD Drawing
FILE: HERP-855.DWG

Figure 1

Section Line : A



Section Line B



LEGEND

——— NERP 1992/93

– – – – – 1963 (4" to 1 Mile Map)

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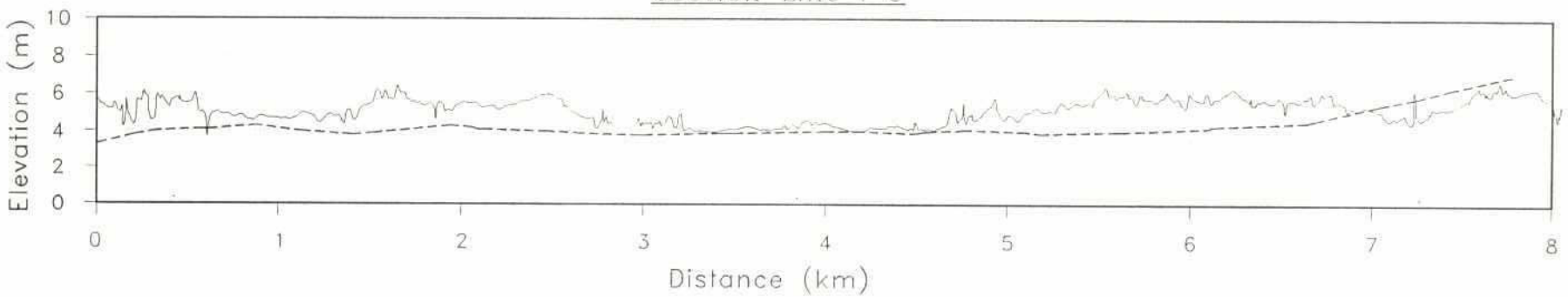
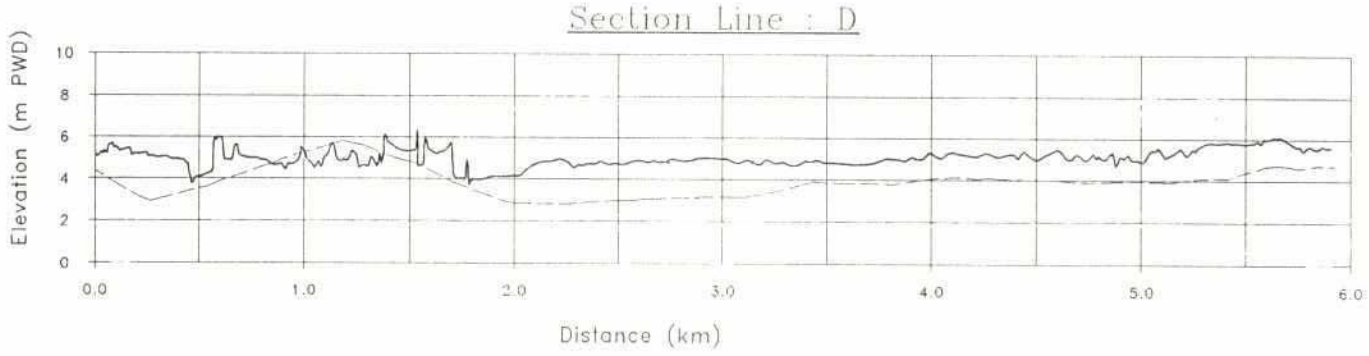




LEGEND

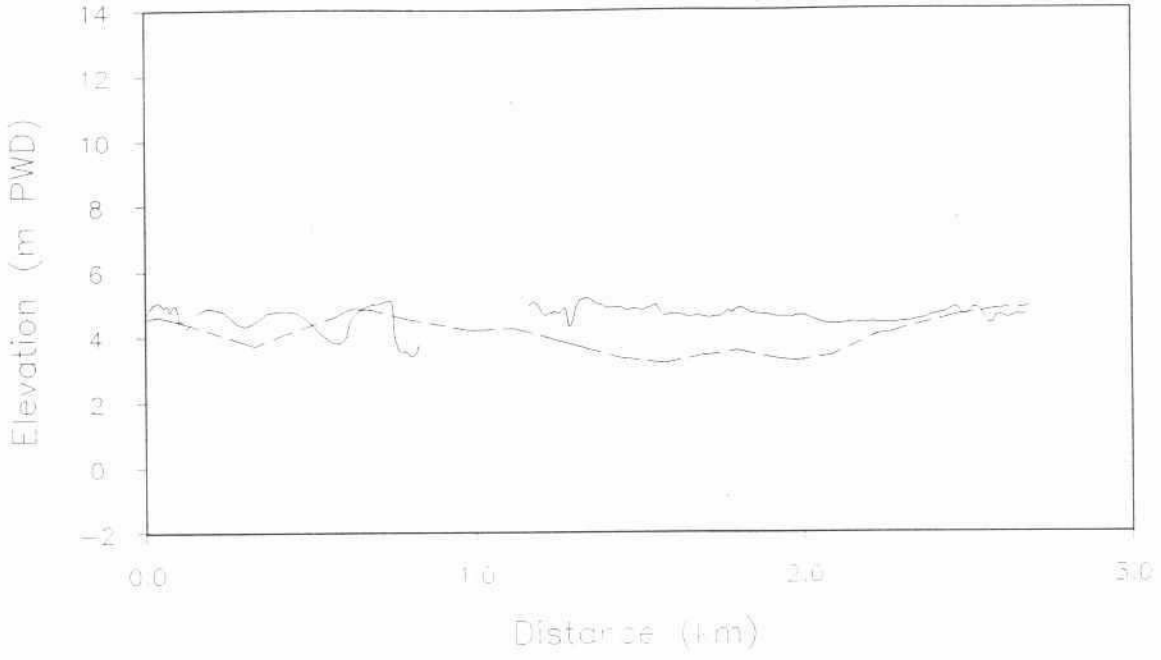
——— NERP 1992/93

- - - - - - - 1963 (4" to 1 Mile Map)

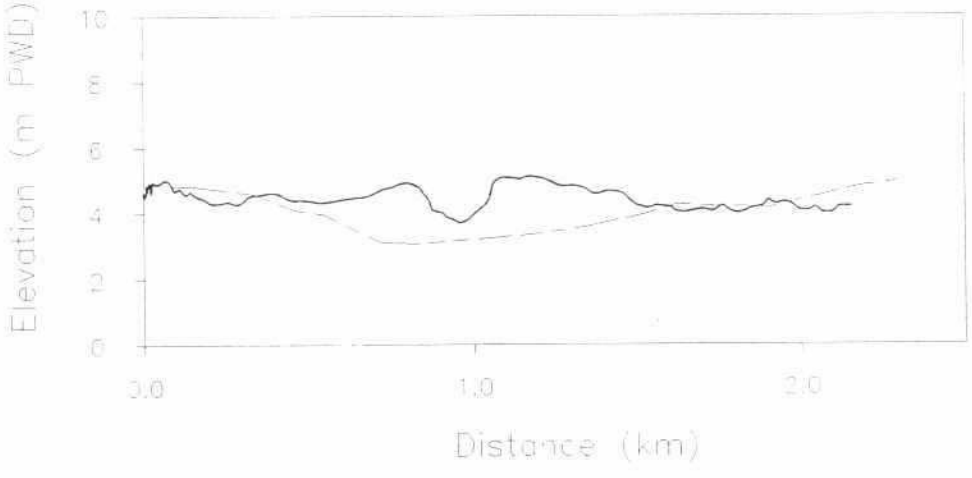
FILE: NERP-861.DWG

Figure 3

SECTION LINE : S1



SECTION LINE : S2



LEGEND

——— NERP 1992/93

– – – – – – 1963 (4" TO 1 Mile Map)

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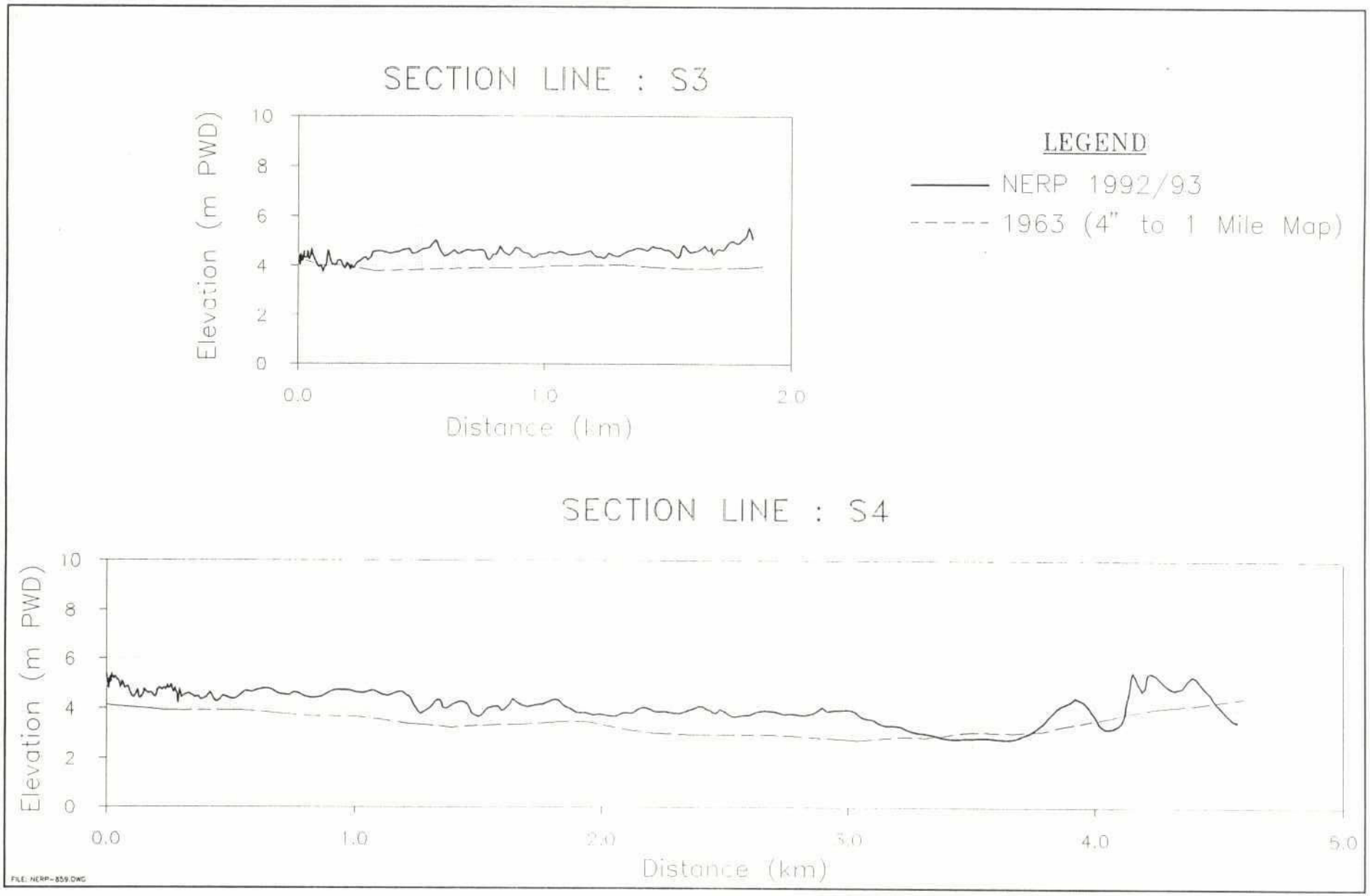
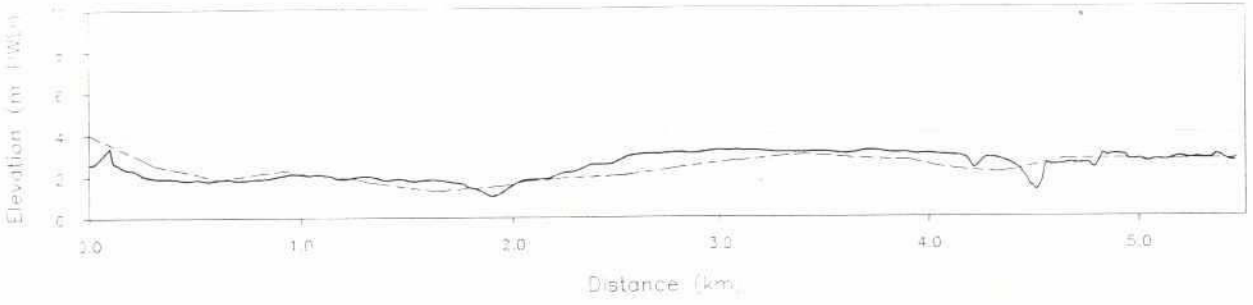
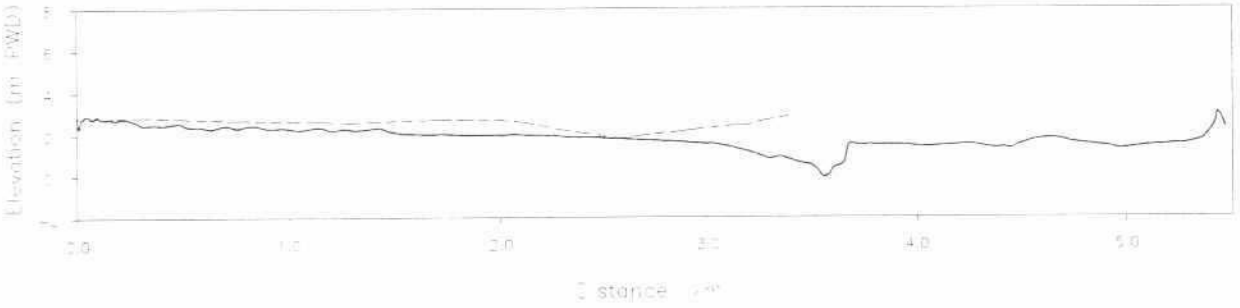

SECTION LINE : S3
Elevation (m PWD)
10
8
6
4
2
0
0.0
1.0
2.0
Distance (km)
LEGEND
NERP 1992/93
1963 (4" to 1 Mile Map)
SECTION LINE : S4
Elevation (m PWD)
10
8
6
4
2
0
0.0
1.0
2.0
3.0
4.0
5.0
Distance (km)
FILE: NERP-859.DWG

Figure 5

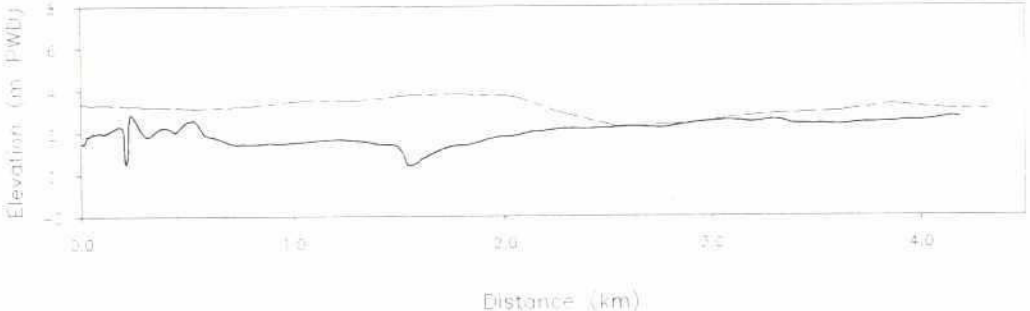
SECTION LINE : S5



SECTION LINE : S6



SECTION LINE : S7



LEGEND

——— NERP 1992/93

- - - - - - - - 1963 (4" to 1 Mile Map)

FILE: NERP-860.DWG

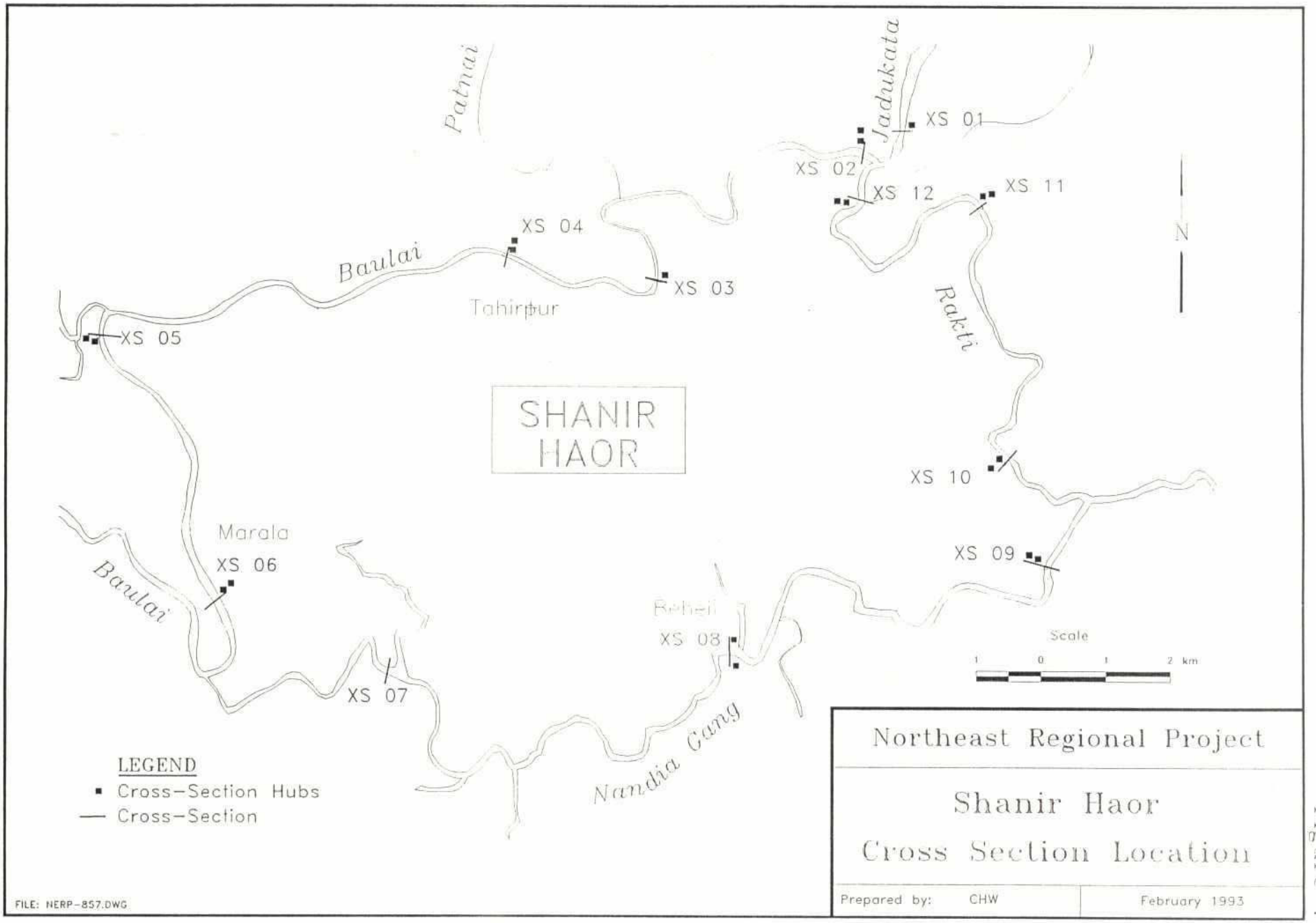

Patnai
Jadukata
XS 01
XS 02
XS 12
XS 11
N
XS 04
Baulai
XS 03
Tahirpur
XS 05
Rakti
SHANIR
HAOR
XS 10
Marala
XS 06
Baulai
XS 09
Behel
XS 08
Scale
1 0 1 2 km
XS 07
Nandia Gang
LEGEND
Cross-Section Hubs
Cross-Section
FILE: NERP-857.DWG
Northeast Regional Project
Shanir Haor
Cross Section Location
Prepared by: CHW
February 1993

Figure 2

CROSS SECTION AT SHANIR HAOR

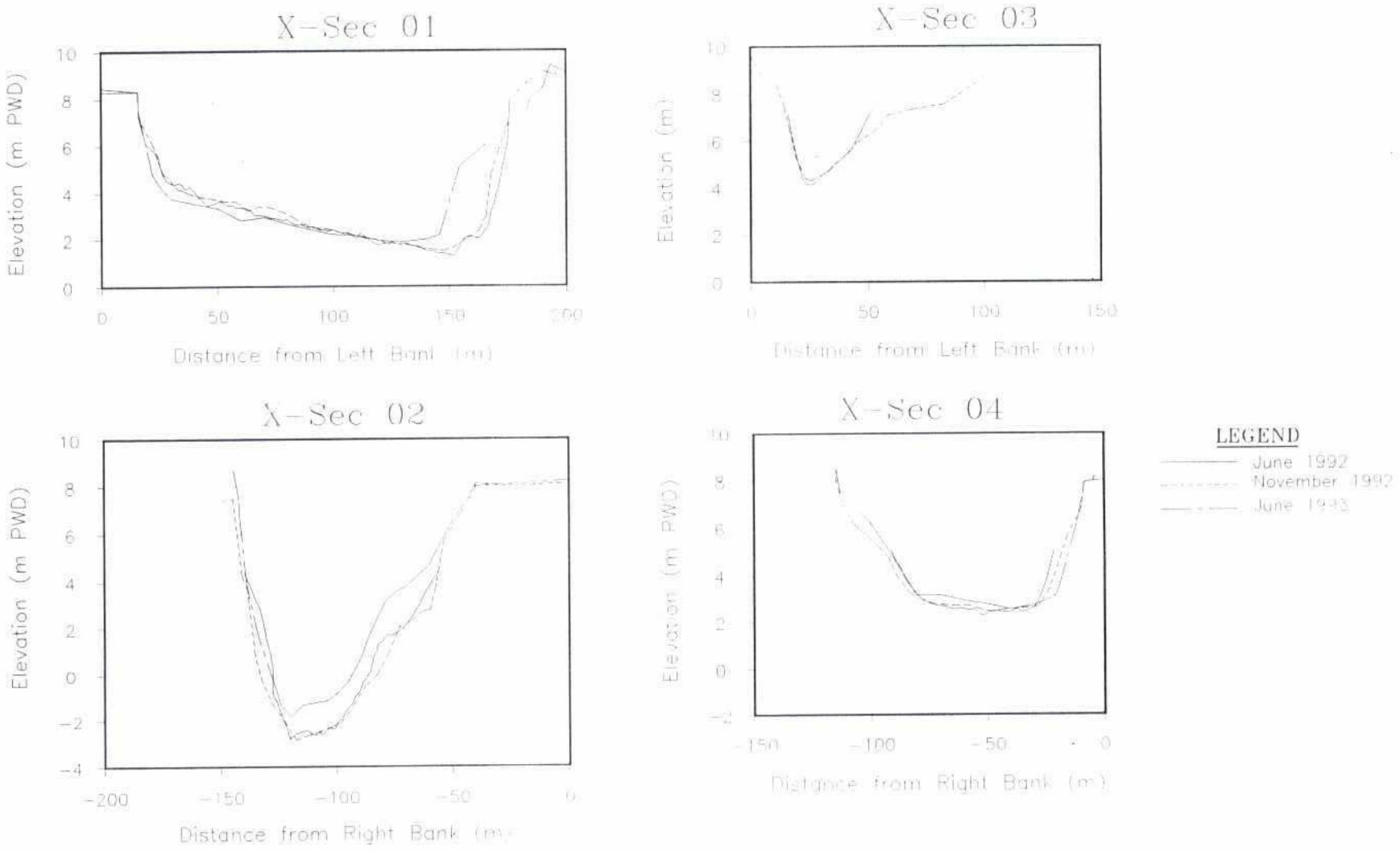


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Figure 8

CROSS SECTION AT SHANIR HAOR

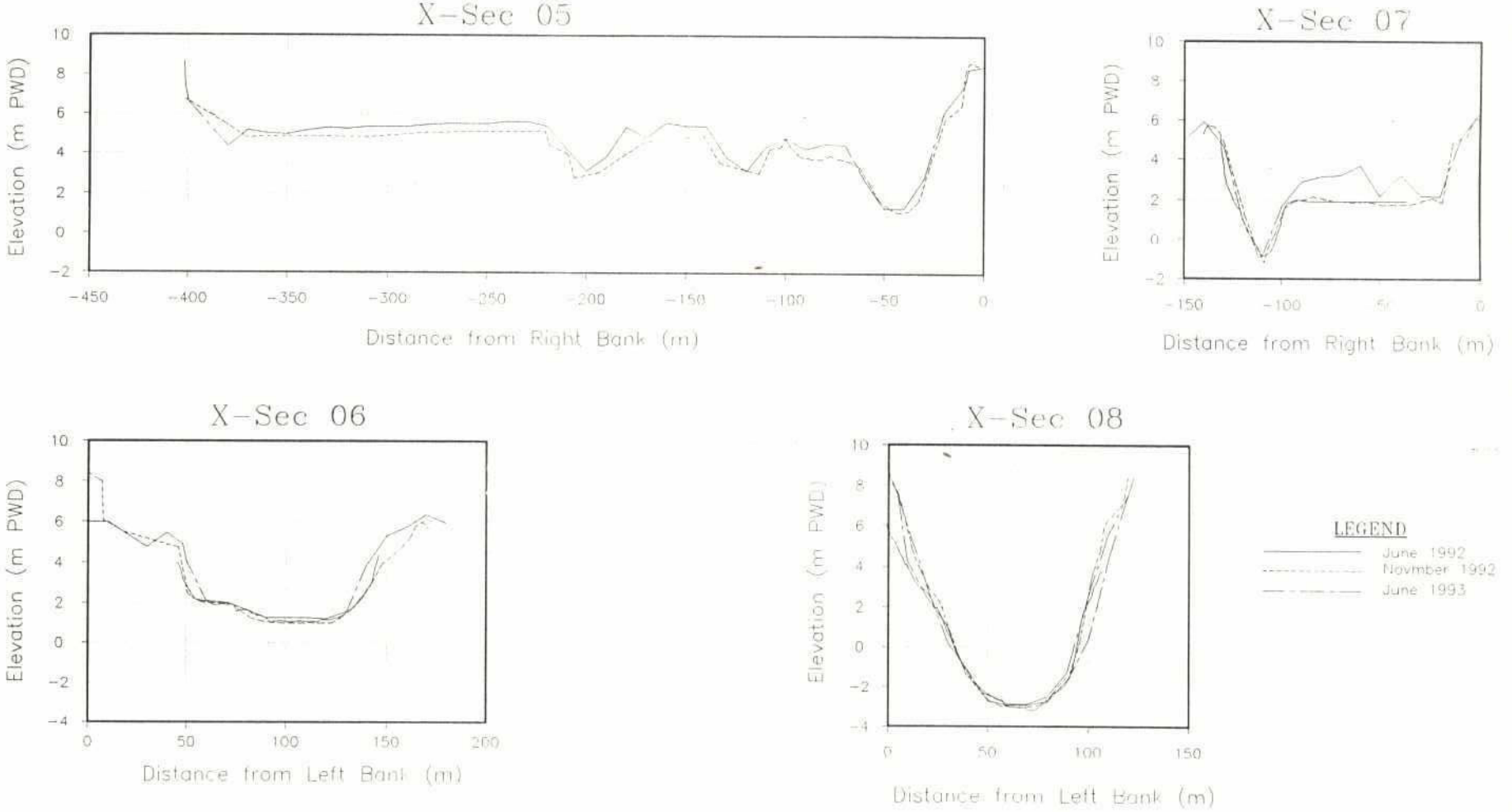

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Figure 9

CROSS SECTION AT SHANIR HAOR

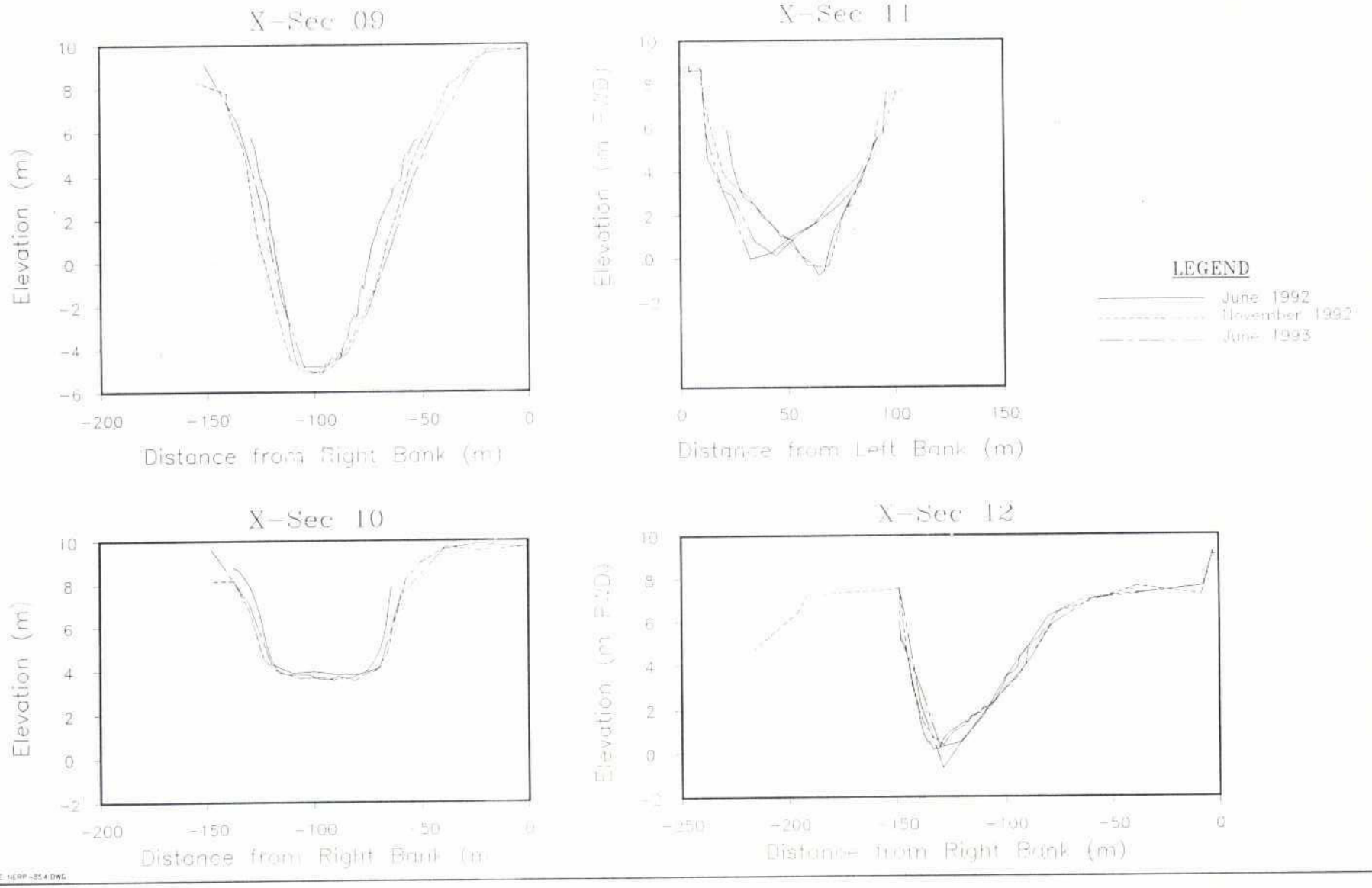


Figure 10

APPENDIX C

SOCIAL ANTHROPOLOGY DATA

APPENDIX C : SOCIAL ANTHROPOLOGY DATA

INDEX

C.1 HISTORY

It is sometimes difficult to match information collected locally with the imperial history of the Mogul and the British governments. Ancient history transmitted orally from generation to generation, invariably, becomes mythology and the interpretation of the accounts collected requires considerable cross checking and time.

Still, it is important to present information collected as it is. We were able to meet excellent informants who are now in their eighties and have therefore witnessed the end of British rule, the abolition of the *zamindari* land tenure system, and the gradual disappearance of jungle in the haor with concomitant extension of rice fields. Such informants are not going to be available for very much longer.

It must be said that interest in history and memory for the past is very lively in the haor, especially amongst descendants of old *zamindar* families.

The Laur kingdom: There is good evidence that a brahmin king, named Dibya Shingha, ruled the kingdom of Laur which was part of the Jaintia Raj in the fifteenth century. His capital was situated at the foothills of the Meghalaya Mountains, along the Jadukata River, some miles to the north of Shanir Haor. The names of villages there, Laurerghor, Rajargaon recall this glorious past.

Ancient sites of religious significance have been preserved along the banks of the Jadukata are testimony to continuity. Every year, on the 13th day of Choitro (31st of March) several thousand

Hindus gather there for a holy purification bath in the Jadukata River and make offering to the goddess Ganga. The myth associated with this pilgrimage refers to a minister of Dibya Shingha and his wife who found in the Jadukata all the virtues of seven holy rivers. Women devotees go there praying the goddess Ganga to conceive a child, or ask for other favours. Both Bengali and Khasi (descendants of the Jain who live in the hills in India) were seen participating in the event on the 31st of March 1992.

Two miles away there is a site in the hills, now in India, where Muslims and Hindus pray to the pir Sharpin (the name is derived from Shah Arifin, a contemporary of Shah Jalal, the great saint credited for large conversion of Sylhetis to Islam). The annual celebration of the pir, which is called *orush*, and the holy bath in the Jadukatha called *Ponatirtha Snan* both take place at the end of March.

This concentration of devotions in one location, at the same time by people professing different religions confirms an observation made elsewhere in Bangladesh that sites with special geographical features whether it be a hill, a river bank, or a pond have maintained their sacred character through centuries with a surprising continuity. This is significant of how the people of Bengal relate to their environment.

There is probably a great deal to learn from studying further the ancient historical site of the Jadukata, gateway between the mountain and the floodplains, meeting point of the Bengali rice agriculturalists and the Khasi people of the hills.

Beheli, the oldest village in the area: Beheli, situated on a high levee on the southeastern side of the haor, was settled about 400 years ago and is by far the oldest village in the area. The Beheli Zamindar is said to have obtained the zamindari title under the Emperor Jahanguir. Such an ancient origin has given Beheli a prestigious position, even though the zamindari itself remained rather small.

The Zamindar of Gauripur: At the beginning of the nineteenth century, most of Shanir Haor was covered with jungle and, as such, was probably not considered a very profitable zamindari to acquire. In the 1820's, most of Shanir Haor was up for auction by the British Raj, but small local zamindars from Beheli, Mussalghat, etc, were not interested, or could not take it up. The Maharaja of Gauripur from Mymensingh thus acquired, as *elam jomi*, most of what later became the agriculture land of Shanir Haor. In 1950, he owned 14/16th of the agricultural land and 8/16th of the fisheries.

The Zamindar of Gauripur administered his estate through several Naiyeb. The Naiyeb responsible for Shanir Haor governed from Tahirpur. The rule and the lifestyle of such a governor appears to have been better regulated than that of a small locally residing ones. There was a check on the excesses or the bad governance of a Naiyeb, and the Zamindar of Gauripur's subjects appear to have been treated better than others.

Bringing land covered with wild vegetation under cultivation entailed bringing cultivators from outside because the haor was then sparsely populated. There were much fewer landless people then, and fewer men willing to work as agricultural labourers, so a landowning family could only cultivate so much. There were service castes attached to zamindar families, some of which cultivated the land of the master but the *nankar* are not the people who brought jungle under cultivation.

In 1913, a first embankment was built by the Zamindar of Gauripur in Shanir Haor. The protective work was completed with a sluice gate, a fine piece of engineering which is still standing today. This early flood control structure shows how actively the Zamindar of Gauripur promoted agriculture. His governor (or *naiyeb*) invited local farmers to clear more jungle land given them concessionary conditions.

The Zamindar of Gauripur patronized cultivators from Mymensingh. Some men from Jungle Bari, now in Karimgonj upazila came as *zirati*, i.e. seasonal migrant farmers, but did not set up homes in Shanir Haor. Others coming from further east, eventually settled in Shanir Haor with their entire family. These settlers were called *Abadi*, a name which is still used today and has pejorative connotation. The descendants of the Mymensingh settlers continue to form largely separate communities.

Throughout the nineteenth century, much of the land which is now Bangladesh was brought under rice cultivation. The process of bringing jungle under rice cultivation was completed in most of Bangladesh by the end of the nineteenth century but it continued at Shanir Haor well into the twentieth century. In the 1930's, it is said that the northeastern part of Shanir Haor, from Fatepur, through Dawa, to Birnagar was still covered with jungle and inhabited by tigers and wild pigs. Today, the process is complete. Shanir Haor in the winter months spreads like one vast paddy field with very little other vegetation left standing.

The social relations which developed under the zamindari system are said to have been especially enduring in the haor where there were several locally residing zamindar who maintained personal links with their subjects.

C.2 LOCAL INITIATIVES AND PEOPLE'S PARTICIPATION IN THE MANAGEMENT OF WATER RESOURCES

History of flood control under different agencies

The people of Shanir Haor have a long experience with flood control works. The construction of a submersible embankment which was completed by an 8-vent sluice gate was initiated under the zamindar of Gauripur in 1915. People built the embankment as paid workers. The zamindar financed the entire work, including the sluice gate, then raised land taxes from 1.50 to 1.70 taka per ker. In this early project, not much was left to local initiative in the management of the work. However, the people of Shanir Haor still feel positive about the intervention which probably answered felt needs.

From the abolition of the zamindari system up to 1965, local people, mainly under the leadership of large landowners, themselves organized the protection of the boro crop against floods. Contributions were raised (chanda tula) from all farmers. This self taxing system more or less stopped in 1965 when union chairmen began receiving food from the central government to carry out the earth work.

In 1976, the BWDB undertook the re-construction of the embankment in Shanir Haor and later replaced the old sluice gate with a 6-vent one built a few metres away from the old one. The new sluice gate is smaller and is equipped with fall boards whereas the old one had been equipped with iron gates. The BWDB project, financed by IDA was not followed by increased taxes for the local inhabitants.

Again, people participated in the earth work as paid workers while the construction of the sluice gate was contracted out to two successive contractors from other districts of the country who employed their own labourers. Contractors changed when a new national government came to power. People's views on the location of the new sluice gate were not taken into account. They requested a sluice gate at Ahmokkhali near the village of Marala which is the lowest entry point into the haor (see map 2). According to BWDB informants, the decision to build only one sluice gate, and one of a cheaper design to be located at Bogiani Khal instead of Ahmokkhali was taken by IDA, the donor agency, to reduce cost.

Cuts in the embankment: a traditional drainage method

Every year in December, the embankment is cut deep at Ahammokhali to drain the lowest agricultural land inside the haor for rice transplantation. Several other public cuts are made (in 1992, 17 were recorded) but Ahmokkhali is the most critical one. It must be closed at all cost when the river starts rising, or else the entire haor gets flooded. The channel at Ahmokkhali is closed every year with traditional methods which include bamboo poles and rope, bamboo mats as well as earth. The BWDB's food-for-work pays for earth work but not for the other materials which are provided by the public

Shanir Haor as a BWDB project

The people of Shanir Haor benefit from a fair degree of flood protection. Moreover, every year, maintenance under food-for-work (which includes filling in the 21 public cuts and breaches) provides an income to poor men and women at a time of seasonal scarcity. But it is said there is more pilferage and negligence than during the zamindar period, or when the public organized the protection of the haor themselves before 1965. Some officials occupying positions in the BWDB, in the thana administration, as well as in local government benefit through the substantial cuts they take from food-for-work allocations.

While the maintenance work is officially going on under the BWDB, the people of Shanir Haor do not "own" the project. Repairing embankment under food-for-work is not seen as a service to the community, but as a business by those who manage it, and a paid job by those who carry out the earth work. Once the official work is completed however, the people of Shanir Haor re-appropriate the embankment and different norms of communal responsibility apply.

The re-appropriation of Shanir Haor by the people

As in Kaliagota Haor, farmers know that they either save or loose their crop together. They are unitedly concerned to have a strong embankment which can effectively delay the flood until the harvest is complete.

There is a permanent organization, the Shanir Haor Development Committee, which has members from each of the 47 villages around the haor. This locally initiated committee defines its own mandate. Its main purpose is to monitor the rise in river water level and the condition of the embankment until the completion of harvest. In March and April, two to three guards are appointed to check the strength of the embankment and the rise of the river. If need be, the public is called to re-inforce a weak spot. After harvest, the guards collect rice (chanda) from farmers as payment for their work. Farmers give willingly for what they regard as a public service.

The committee also co-ordinates cuts in the embankment which are made in November and December to gradually drain the haor to permit the transplantation of rice seedlings. Cuts in the

submersible embankment of the haor are systemic. They are part of the water management system people have evolved.

Every year, the committee holds two public meetings which are open to everybody. In the past, those who sanctioned sub-standard work on the embankment against bribe or personal gain have been publicly exposed. The committee leaders maintain some unofficial contact with the BWDB office in Sunamgonj.

Comments on people's participation in Shanir Haor

1. People, organized into a committtee led by large landowners, take over the responsibility to protect their haor when food-for-work is officially closed. For this limited purpose, the organization has been quite effective. The committee represents above all the interests of farmers. However since everybody is a rice eater, the success of the harvest is a widely shared interest by all the inhabitants.

   Observations made for Kaliagota Haor regarding the hierarchical structure of society and the strict division of class and gender roles apply to Shanir Haor as well.

2. The BWDB is seen by the people of Shanir Haor as a bureaucratic organization which is not equipped to cope with crisis. The people of Shanir Haor see the BWDB staff as job holders who are not accountable to them. Over time, some people have become more passive in their attitude to BWDB and their expectations have changed. The BWDB is blamed for not attending to needs which previously people took care of themselves.

3. The leakages in food-for-work are systemic. The local inhabitants are aware of these leakages which are a disincentive to people's voluntary participation. Men called to work freely afterwards feel cheated.

4. The people of Shanir Haor are very critical of the sluice gate which was built with IDA funding and one should not expect them to develop a sense of responsibility towards a project in which they had no say and from which they derive so little benefits, if at all. The sluice gate does not function as a regulator of floods since the fall boards cannot be lifted when there is a big difference between haor and river levels. It does not drain the haor as effectively as the Ahmokhali cut because the level of the Abbua river (also known as Nandia khal) which runs to the south is higher than that of the Baulai river. At best, the sluice gate functions as a cross dam, but not a very effective one at that. In 1993, an earthen cross dam had to be built in front of the sluice gate as it leaked profusely in between the boards.

Recommendations

1. It is recommended that the people of Shanir and other haors be given the responsibility to maintain their embankment. Food for work (or cash for work) should be managed at the haor level provided adequate measures are set in place to ensure accountability. It should be possible to improve on the present losses by letting the public know how much is allocated to their union for earth moving work and ensure easy access to courts to deal with malpractices.

2. If people value the sluice gate as it is now, fall boards which are reportedly missing every year should be replaced by the public. And if people do not value the structure, it should be abandoned. The operator should not be a paid employee of the BWDB. Someone should be appointed by the local community and get paid through chanda, or collection in kind after harvest. Such payment for a public service is a well established tradition in haor society. If the operator has not served the public, then farmers will refuse chanda.

3. In water management schemes under local initiatives, local people contributing money or labour provide an effective mechanism. This may be reinstated in Shanir Haor, as well as other haors. In this case there should be a state subsidy to supplement local efforts and initiatives.

4. Providing subsidies to supplement local contributions is likely to be much cheaper than the present maintenance system. The money saved should be made available for other local schemes which respond to locally felt needs. For example, planting hizol and koroch trees in front of villages which are seriously threatened by erosion, or extending the village mound in front of a school, thus providing extra space to dry grain and straw, to live and play.

5. The BWDB could play a technical advisory role when necessary.

6. Public subsidies, should be attached certain conditions, for example requiring that a share of the work be allocated to women. We have seen that this does not necessarily happen with schemes under local management.

7. Union parishad members could play an important role in the management of flood control, and indeed many have done so in the past. Union parishad members are likely to be large landowners and that in itself is a strong motivation for their participation. But there should be no rigid rules giving a monopoly to union parishad members in this function. The public should be given the option to choose their leaders.

POPULATION STATISTICS TABLES

Table C1: Population by age and sex

Age	Male	%	Female	%	Total	%
00-04	27	14.75	18	13.24	45	14.11
05-09	28	15.30	24	17.65	52	16.30
10-14	25	13.66	13	9.56	38	11.91
15-19	16	8.75	13	9.56	29	9.09
20-24	16	8.74	11	8.09	27	8.46
25-29	16	8.74	12	8.82	28	8.78
30-34	09	4.92	07	5.15	16	5.02
35-39	12	6.56	07	5.15	19	5.96
40-44	08	4.37	09	6.62	17	5.33
45-49	06	3.28	05	3.68	11	3.45
50-54	03	1.64	01	0.74	04	1.25
55-59	05	2.73	04	2.94	09	2.8
60+	12	6.56	12	8.82	24	7.52
Total	183	100	136	100	319	100

Source: NERP sample survey

Table C2: Literacy level

Literacy level	Male	%	Female	%	Total	%
Illiterate	125	68.31	114	83.82	239	74.92
Primary	47	25.68	22	16.18	69	21.63
Secondary	08	4.37	-	-	08	2.51
S.S.C +	03	1.64	-	-	03	0.94
Total	183	100	136	100	319	100

Source: NERP sample survey

Table C3: Marital status

Marital status	Male	%	Female	%	Total	%
Never married	119	65.02	63	46.32	182	57.05
Married	64	34.97	58	42.65	122	38.24
Widowed	-	-	15	11.03	15	4.70
Divorced	-	-	-	-	-	-
Total	183	100	136	100	319	100

Source: NERP sample survey

Table C4: Occupational distribution of population

Occupation	Male	%	Female	%	Total	%
Agriculture	77	42.08	-	-	77	24.14
House work	-	-	77	56.62	77	24.14
Service	03	1.64	-	-	03	0.94
Wage labour	24	13.11	03	2.21	27	8.46
Trading	01	0.55	-	-	01	0.31
Student	31	16.94	10	7.35	41	12.85
Children	27	14.75	18	13.24	45	14.11
Dependent	15	8.20	23	16.91	38	11.91
Inactive	-	-	05	3.68	05	1.57
Rakhal	03	1.64	-	-	03	0.94
Others	02	1.09	-	-	02	0.63
Ttotal	183	100	136	100	319	100

Source: NERP sample survey

C.3 SITUATION OF WOMEN

Women are engaged in various economic activities and chores. Some of the activities are performed round the year and some in specific seasons. Nature and seasonality of activities often vary among different socio-economic strata. This has been presented in activity calendars separately for landless, small, medium and large farm households for class A, B, C and D respectively. (See following two pages).

Women are engaged in cleaning khola from the beginning of dry season. They smear the floor of the khola and golaghar. No cash wage is given if labour is hired. But one meal is offered in exchange of work.

Women of all strata collect singra from the haor. However, only poor women sell singra.

Women are also engaged in winnowing of crops. The daily wage is 5 taka. Some are given only food and no cash wage. Rice husking is done manually by women only in Baishakh. In other months, rice is husked in the mill.

Women agree to work in exchange of food and do not insist on cash wage as they think that raising a demand for cash wage may jeopardise the relationship with the employer. At the time of need, they can get some rice or vegetables from the well-to-do households.

In Islampur and Nayanagar, all women are involved in gleaning of rice from the haor. But in Fatehpur, only children and old women belonging to poorer strata are engaged in rice gleaning. This year (1993), less rice was available through gleaning compared to previous years. About 7-8 kg of rice can be collected by one person in a day.

C.4 WAGES

January 1993: Wage rate for male labourers:

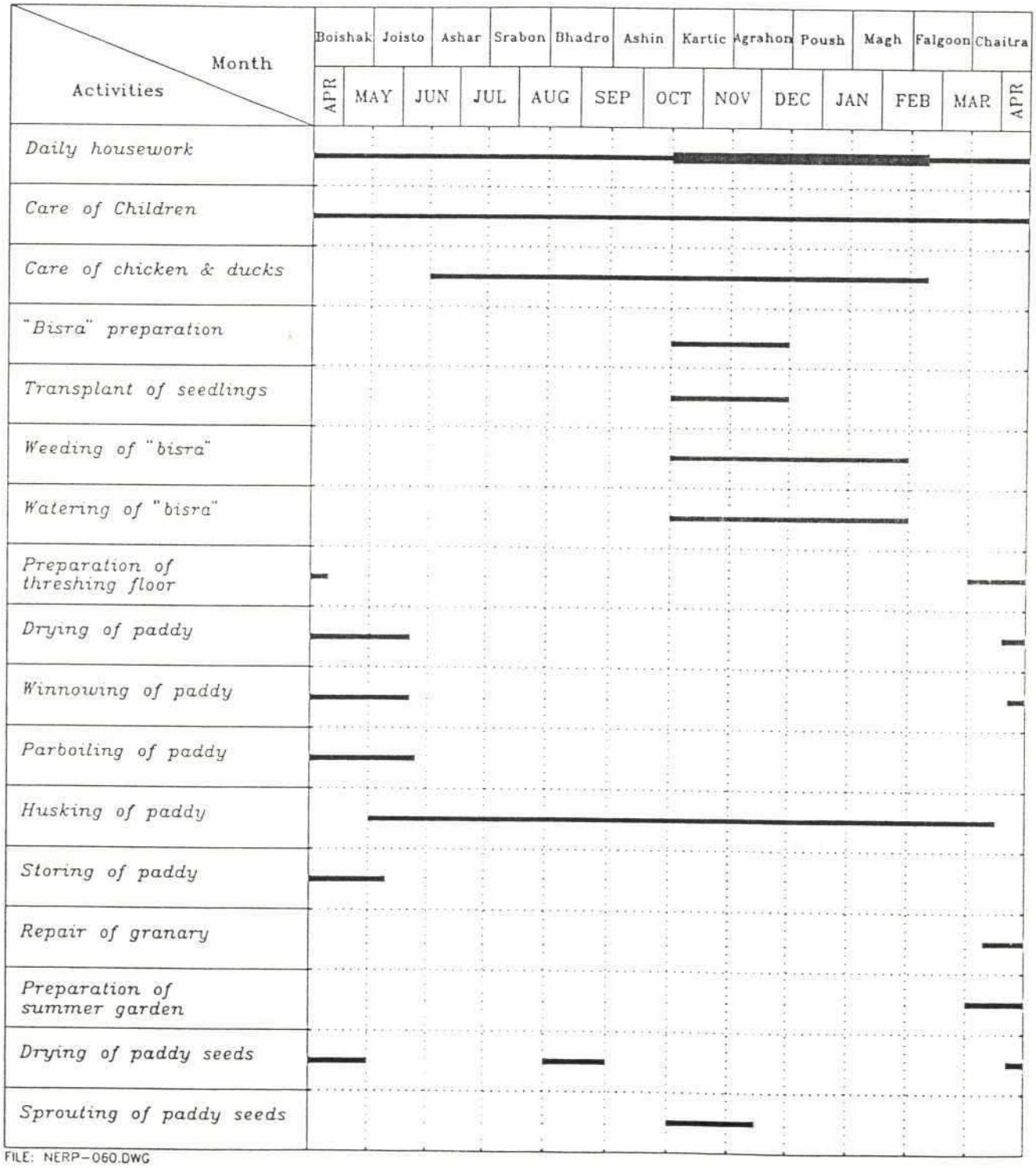
Period	Daily wage (tk)	
	Without food	With food
1st week	30	25 plus 1 meal
2nd-3rd week	35-40	30-35 plus 1 meal
4th week	25	20 plus 1 meal

Wage rate for child labourer is tk 10 per day plus food. Women are engaged in preparing bisra with spade or do weeding in bisra. The daily wage is tk 15 plus one meal or tk 20 without food. The wage rate for uprooting boro seedling from the seed-bed is tk 12-15 plus one meal.

February 1993: The daily wage rate for male labourers is tk 25-30 without food. Some labourers went to Bholaganj in search of work.

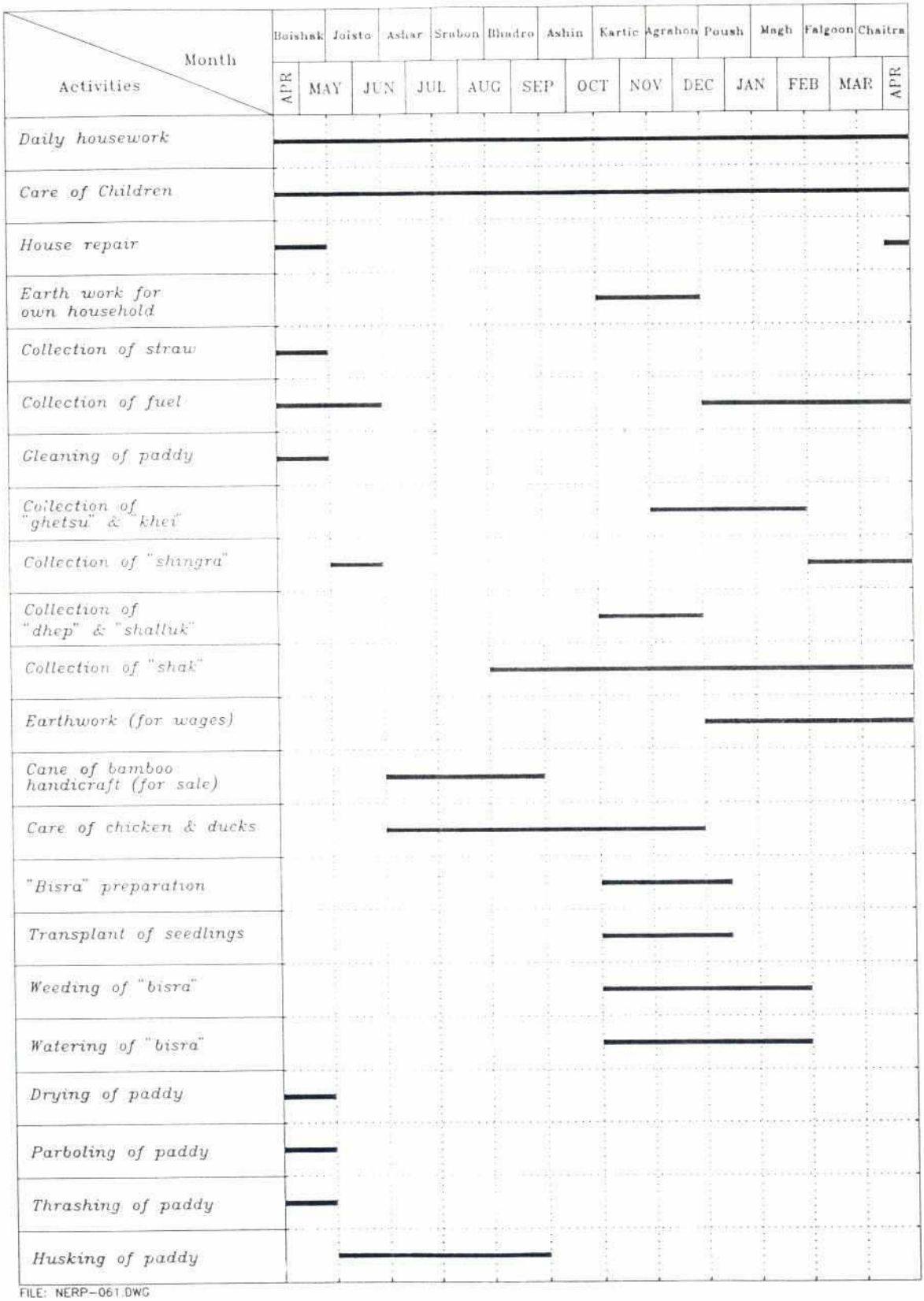
March 1993: The daily wage for harvesting boro is tk 50 plus one meal. A male labourer engaged on a monthly basis gets 7-9 maunds of rice as wage.

CALENDAR OF WOMEN'S WORK
LANDED HOUSEHOLDS (Classes A & B)



FILE: NERP-060.DWG

SHANIR HAOR 1991–1992
CALENDAR OF WOMEN'S WORK
POOR HOUSEHOLDS (Classes C & D)



FILE: NERP-061.DWG

September 1993: Wage rates for different types of work in Shanir Haor presented below:

Table C5: Wage Rates (September 1993)

Type of work	Daily wage rate
Agriculture (all types, highland areas)	Tk 25 plus two meals
Cutting tree (for fuel)	Tk 30 plus two meals
Handicrafts (bamboo work)	Tk 20 plus two meals
Carpentry	Tk 25 plus two meals

Source: Field observation

October 1993: The labourers have already been recruited for boro season and got admitted to the mahajan's house. In most areas of Shanir Haor, the seasonal labourers employed for 7-8 months have reported to respective mahajan's house by 20-25 October. The seasonal wage ranges from 20 to 25 maunds of rice plus three meals and clothes. The wage is generally be paid after the harvest. A certain amount of rice, such as, 4-8 maunds would be paid in advance before the harvest as per agreement. If someone takes more in advance, either cash or rice, which are not included in the agreement, one has to repay the amount with the prevailing rate of interest for non-institutional credit. Rakhals are also employed for 6-7 months. The wage is 1 to 4 maunds of rice plus three meals a day and clothes. Earth work in the village of Islampur is going on. Two female groups, each comprising five members, are involved in earth work. Only one male person is included in each group. The daily wage for each labourer is 25 taka. Along the road from Anwarpur to Fazilpur, earth work is going on under the local government initiative. Twelve labourers are working there. The daily wage per labourer is 50 taka.

November 1993: Wage rate for harvesting aman rice is one-seventh to one-eighth of the total harvested rice. Wage rate for different activities are presented below:

Table C6: Wage Rates (November 1993)

Type of work	Daily wage
Agriculture (seed sowing, ploughing, transplantation)	25 taka plus two meals
Earth work	30-35 taka without food (for male), 25 taka without food (for female)
Chopping tree for fuel	25 taka plus two meals
Carpentry	70 taka plus two meals
Handicrafts (bamboo/cane work)	25 taka plus three meals

Source: Field observation

December 1993: Daily wage rate for transplantation:

1st week:	30 taka without food
2nd week:	35 taka without food
3rd week:	40 taka without food
4th week:	45 taka without food

Wage rate varies in different types of work. For example:

- uprooting of seedling from the see-bed: 4 taka per twenty bundles of seedling;
- irrigation with the traditional don method: 40 taka per day plus two meals;
- earth work: 40-50 taka daily for male, 30-35 taka daily for female;
- carpentry: 80 taka daily plus two meals;
- chopping wood for fuel: 40 taka plus one meal.

January 1994: Daily wage for different activities are:

Boro transplantation		Tk 30-40, without food
Earthwork:	male	Tk 40-50, without food
	female	Tk 30-45, without food
Picking up seeling		Tk 35, without food
Irrigation by don		Tk 30 plus two meals
Chopping wood for fuel		Tk 40 plus one meal

C.5 CREDIT

For a loan of 1,000 taka borrowed in the month of Kartik/Agrahayan, the borrower is to pay 8 to 9 maunds of rice in Baishakh. For a loan of 100 taka, one maund of rice is to be paid. In case of cash repayment, the rate of interest is 50% to be paid in Baishakh.

C.6 MIGRATION

In the haor area during the rainy season there is little scope for work. Labourers usually go out for work to different places.

Table C7: Seasonal migration from Shanir Haor (June 1993)

Village	No. of labourers migrating	Place of migration	Activities performed
Sahebnagar	13	Sylhet Bholaganj Fazilpur	Agriculture
Shibpur	40	Bholaganj	Sand, boulder carrying
Chandipur	12	Bholaganj	Sand and boulder carrying
Islampur	50	Bholaganj	Sand and boulder carrying
Nayanagar	30	Sylhet Bholaganj	Agriculture, sand and boulder carrying
Ikrampur	40	Bholaganj Fazilpur	Sand and boulder carrying
Barkuri	20	Bholaganj Fazilpur	Sand and boulder carrying
Naya Barunka	30	Bholaganj Fazilpur	Sand and boulder carrying
Nayagaon	35	Bholaganj Fazilpur	Sand and boulder carrying
Roingarchar	50	Sylhet Bholaganj Fazilpur	Agriculture, sand and boulder carrying
Fatepur	80	Chhatak Barlekha Chittagong	Agriculture, sand and boulder carrying, construction
Aladar	10	Bholaganj	Sand and boulder carrying
Alipur	50	Sylhet Bholaganj Fazilpur	Agriculture, sand and boulder carrying
Puran Barunka	50	Bholaganj Fazilpur	Sand and boulder carrying
Masudpur	45	Bholaganj Fazilpur	Sand and boulder carrying
Radhanagar	200	Sylhet Bholaganj Fazilpur	Agriculture, sand and boulder carrying
Marala	40	Bholaganj Fazilpur	Sand and boulder carrying

Source: Field observation

Table C8: Seasonal Labour Migration (July 1993)

Village	No. of migrated labourer	No. of boat	Place of migration
Birnagar	100	30	Fazilpur, Bholaganj, Chhatak and Sylhet
Sahaganj	30	7	
Chikash	400	75	
Joynagar	50	20	
Dutma	80	15	
Dakshimukul	450	130	
Fazilpur	30	10	
Nayahat	30	10	
Anwarpur	250	80	
Louhachara	100	50	
Pathri	30	10	
Masudpur	50	10	
Puran Barunka	250	40	Bholaganj
Alipur	80	10	
Anantapur	200	60	Bholaganj and Fazilpur
Basantapur	500	50	
Bouya	150	40	
Shahapur	200	50	
Rajendrapur	150	20	
Mashalghat	200	20	
Islampur	200	37	
Chandipur	20	7	
Shibpur	30	6	
Radhanagar	300	10	
Fatepur	50	6	

Source: Field observation

Table C9: Seasonal Labour Migration (July 1993)

Village	No. of household	No. of labourer	No. of barki	Place of work and type of work
Beheli	176	57	6	Bholaganj, Fazilpur, Sylhet: carrying Boulder Goyalabazar, Ajmiriganj: agriculture, shopkeeping
Islampur	160	172	31	Bholaganj
Marala	67	40	0	Bholaganj, Fazilpur, Chhatak
Anowarpur	210	240	70	Fazilpur
Fatepur	106	50	6	Bholaganj: carrying firewood and boulder by boat
Sublargaon	120	115	14	Bholaganj: carrying boulder
Birnagar	131	106	31	Bholaganj, Fazilpur: carrying boulder
Total	970	780	158	

Source: Field observation

December 1993: A large number of labourers are still working in different places, such as t.aman harvesting in Sylhet and carrying sand and boulder in Bholaganj and Fazilpur. Many labourers form different villages are involved in agricultural work in Halir Haor form the third week of December on daily basis. It is reported that there is shortage of labourer in Shanir Haor during the boro season due to out-migration.

C.7 CARRYING SAND AND BOULDERS

Many people are involved in carrying sand and boulder during the monsoon months. There are 2-3 boats in every village of Shanir Haor for this purpose.

Barki

Small boats involved in carrying sand and boulder are locally known as barki. Information have been collected form some barkiwala of Dakshinkul, Anwarpur, Lohachhara and Bardal and Fazilpur.

The labourers collect different sizes of boulder during the monsoon, particularly in July, in Fazilpur and sell these to retail buyers. Mohajans from different places purchase these from retailers and then supply these things to different places in bulk quantity.

During the monsoon of 1993, the price of boulder decreased by 50% compared to that of the previous year due to increase in the number of boats. The situation has been presented below:

Table C10: Price of Boulders

Size of barki	Price of boat-load of boulder in 1992 (Tk)			Price of boat-load of boulder in 1993 (Tk)		
	Big	Medium	Small	Big	Medium	Small
Big (50 feet)	500	400	300	250	200	150
Medium (40 feet)	400	300	200	200	150	100
Small (30 feet)	300	200	100	150	80	70

Source: Field observation

One big or medium-size barki is operated by three persons and that of a small one by two persons. No tax or rent is to be paid to the lease-holder of the area from where boulders are collected. The lease-holder collects tax from the local retailers who buy boulder from the barki. Boulders are collected from the border area of Bangladesh and India. One barki can make one round trip in a day.

In Fazilpur, there are about 29 local purchasers and a few mohajans. A mohajan possessing boat normally gets 600 taka per month by renting out the boat. In Fazilpur, there are about 150 male labourers and 30 female labourers who are involved in crushing boulders. They are from different villages, such as, Dakshwainkul, Fazilpur, Nayarhat, Anwarpur, etc. A male labourer gets Tk 40-45 and a female labourers gets Tk 30-35 per day as wage.

In Bholaganj, there are four types of boulder. Tk 30 per barki boat is to be paid to the lease-holder of sand and stone and Tk 20 to the leaseholder of the river. Besides, Tk 3 per boat is to be paid to the guard who takes care of the boat at night. The labourers stay in the area from where boulders are collected by constructing temporary shelter made of straw, bamboo and polythene. Due to increase in the number of barki, the price of boulders fell sharply. The situation of Bholaganj is presented below. Data correspond to boat-load of materials carried by a 60-feet boat.

Table C11: Price of Boulders

Size of boulder	Price in 1992 (Tk)	Price in 1993 (Tk)
Big (dak)	700	500
Boulder	500	300
Medium (bhutu)	400	200
Small (single)	250	100-150

Source: Field observation

In Bholaganj, those who do not have any boat, they have to hire it. The rent of a boat is 1200 taka per month. One labourer can earn 30-40 taka in a day after deducting all expenses.

C.8 EMBANKMENTS AND THE PUBLIC

Public cuts

The embankment was cut or breached at 21 locations from Jaishtha to Poush. The causes are:

(1) The people cut embankment to catch ujaiya maachh;
(2) Some portions are cut by farmers/boatmen to ply boat;
(3) Some portions are cut by farmers to drain out water.

During the post-monsoon period in 1993, cutting of embankment by farmers had been rarely observed, because water of the haor had rapidly receded. On 15 December 1993, the embankment at Shimerkara situated in between Nayabarunka and Fatehpur was cut to drain out water form the haor for transplantation of boro.

On 17 December 1993, there was another cut in Chatal. There are some outlets in Khanjauri, Ramjivanpur, Ahammakkhali which are used for draining out water. From 15 December, water was also going out through the Bogiani sluice gate.

People cut the embankment to drain out water as there are not enough outlet for drainage. Land-owners who benefit from this drainage bear the expenses of the public cut. Location and date of some public cuts are presented below:

Table C12: Public Cut of Embankment

Location	Date
Simerkara	15 December 1993
Behelir barir nama	1 January 1994
Gongar bondh (Atla)	8 January 1994
Barkurir khal	9 January 1994
Menar dair	10 January 1994
Shonirua	10 January 1994
Beheli khaler bundh	11 January 1994
Chatal	13 January 1994

Source: Field observation

Breach in embankment

Besides public cut, there are breaches in the embankment due to various reasons. Some of these are observed to be as follows:

(1) Earthwork has not been done properly and the soil compaction work is poor;
(2) Incessant rain soon after the earthwork causes erosion and breach in the embankment. It has been found that heavy rain from 25 to 27 March 1994, strong wind, increased water level in the river and consequent wave action have

weakened the embankment.

From 26 March 1994, water started entering inside the embankment. In the morning of 28 March, the Shonirua embankment breached. It rained continuously on 28 March which inundated ripe rice crop of Shonirua, Atlai and Chatal. While people took the initiative to repair the breached portion of the embankment in Halir Haor, no such initiative was observed at that time in Shanir Haor.

About 100 haal land were affected. About 90% of affected lands are owned by the farmers of Beheli and the rest 10% are owned by the people of Radhanagar and other areas. Usually crops of this area are harvested earlier. But the inundation at this time of the year was unprecedented while the harvesting was supposed to start after only six days. Some farmers went to the haor with boat and started harvesting dhaner shish.

On 28 March, leakage was observed near Barirlama and Krishnatala. The people assembled in the vulnerable point at night and worked together to save the embankment. They also used sand and gunny bags in addition to soil to close the breach. All these cuts and other breaches are closed/repaired by the BWDB. If rain water or monsoon water comes before the cuts are closed, then the people take the initiative to close these. This year (1993), they repaired some breaches on their own at Shamiroa, Putichura and Ahmedkhali after heavy rainfall in February. Sometimes, the people excavate canal bed to drain out water instead of cutting embankment.

Repair of embankment by BWDB

The BWDB took the initiative to repair the embankment. As the haor includes five unions, five Project Committees were formed to implement the work. The repair work commenced in January 1994 which includes, among others, closing of nine breaches including six public cuts in Beheli, closing of twelve breaches including two public cuts in Fatehpur union, closing of nine breaches in Balijuri union, closing of three breaches in Tahirpur union and closing of six breaches in Dakhshin Sripur union.

Protection of embankment by the people: April 1994

The people are protecting the embankment using bamboo, mat, gunny bag, etc., and are guarding it round the day in rotation so that people of adjacent haors do not cut the embankment to drain out water from other haors. Police is also patrolling. Four parts of the Shanir Haor embankment became vulnerable: Ahmokkhal bundh, Bogiani sluice, Shabnagar bundh and Putijora bundh following heavy rainfall since the morning of first April. The people and the police jointly repaired the eroded parts and guarded the vulnerable sections of the embankment.

The Project Chairman (Quddus Ali) has been blamed for negligence in undertaking protective work of the embankment done earlier. When Shnirua embankment breached, he was absconding.

C.9 FLOOD

Most of the people are poor and they mainly live on wage labour and fishing. Situation worsened during the post-flood period. Sometimes, the people have to shift to safer places for shelter and stay there till the water level falls.

There is crisis of fodder due to flood. Many farmers have to sell their cattle at low prices. Cattle diseases also break out. Whatever income is earned, the most of it is to be spent for the protection of homesteads.

Problems of drinking water

There is shortage of tubewell. During the time of flood, people cannot go out to bring tubewell water from another para or village. In the crisis period, about 90% people have to drink water of the haor. As a result, water-borne diseases are very common in the haor area. About 5-6 persons in almost all villages are suffering from diarrhoea. Besides, malaria prevails in most of the households. The poor people cannot afford curative medical care. The local facilities for health care are too inadequate.

C.10 HOMESTEAD PROTECTION

Bari bandha

About 60 years ago, different types of bon (forest), such as, nalkhagra, bantulshi, boula, etc., grew in Shanir Haor which were used for baribandha (protection of homestead). Now these are rarely found. Chailla bon are mainly used for construction of aar (protective fence made of bamboo and chailla bon). Alternatively the people now use water hyacinth, tulkalmi, bishkutali, kukuribon, etc., for protection of homestead platform against wave action. But these types of bon are easily perishable.

In April 1993 during the period of boro harvesting, water entered Shanir Haor and inundated low lands which were filled with chailla bon. Due to this flash flood, about 80% people could not collect necessary materials for construction of aar timely. On the other hand, price of bamboo was high. That is why, many poor people could not take protective measures and many of their homestead platforms were partially eroded.

Chailla bon mixed with soil is normally used as protective wall in the slope of the homestead platform. This is locally termed as guira ban. Given the scarcity of chailla bon, the poor people use bishkutli, kukuri, water-hyacinth, etc., for the construction of guira ban. Information related to bari bandha in selected villages of Shanir Haor in June 1993 are presented below:

Radhanagar

This village consists of 200 households having four paras. Among them, 5 households are well protected as they used boulder in the protective work. Others made temporary walls using different bon, such as, chailla, bishkutli, kukuri, kalmibon, water hyacinth, straw and bamboo. Due to erosion of homestead by wave action, most of the homesteads of this village are shrinking day by day.

Shahebnagar

Nine households affected by erosion due to wave action shifted from this village to other places since 1970.

Due to violent wave action on 11 June 1993, the northwest side of the village eroded to the extent of seven meters. Consequently, one homestead was washed away completely and three others eroded partially. At present there are 25 households in the village having two para. Among them, one household is protected with stone and others have temporary wall made of bon and

bamboo. Due to flash flood in April 1993, most of the villagers could not collect necessary materials from the haor for baribandha. In June, most of the people were involved in collecting water hyacinth from different places by boat and some were busy in collecting straw from inundated fields.

Once this village had about 80 households. Due to the erosion, many had to shift to different places by selling their agricultural land during last 20 years. Now this village has only 18 households. The violent wave action of 11 June 1993 wiped out homestead of two families. Others except three are facing problem of erosion. Due to flash flood in April, most of the villagers did not get time to prepare protective wall around their homesteads.

Marala

Now this village has 67 households having three para. In the past, this village had about 95 households. Due to wave-action, particularly in 1974 and 1988, most of the homesteads of the village were affected by erosion. Some families shifted to different places. The village became smaller. One para has already been wiped out due to erosion. In June 1993, six homesteads were entirely eroded due to violent wave action in the eastern and southern side of the village. Some families took shelter in the premises of the local primary school and some others moved to the house of neighbours.

Nayanagar

This village had about 95 households having 5 para. Due to erosion, the village area has been decreasing. During the floods of 1974 and 1988, 25 households migrated to the other villages as they lost their homestead. In 1992, 6 families shifted to other villages. Among them, some have also sold their agricultural land. At present this village has 64 households having 3 para, while 2 para were completely eroded.

Ikrampur

There are 65 households in this village having two para. About 40 households migrated to other places as they had lost their homestead due to erosion. At present this village consists of only 25 households having one para. On 11 June 1993, the eastern side of this village eroded to the extent of more than two meters. As a result, two homesteads were entirely wiped out.

Shibpur

Homesteads of every household of this village were partially eroded by wave action on 11 June 1993. In the eastern side of the village, 40 fruit trees were also damaged. One homestead was completely eroded and the members of the family took shelter in a neighbour's house. At present this village consists of 79 households having 4 para.

Chandipur

The village comprises 55 households in 3 para. Among these households, 5 are well protected with boulders in the western para. Due to wave action of 11 June 1993 western and southern parts of the village were eroded to a length of about two meters. Besides, homesteads of two families were eroded to an extent of about four meters.

Islampur

Only one homestead is protected with stone. The wave action of 11 June 1993 eroded the west and southern side of the village to the extent of 4 -5 meters and many trees were lost.

Barkuri

The village consists of 38 households having two para. No homestead has adequate protection against wave action. Most of the people are poor. The consequent wave action of June 11 1993 wiped out homesteads of 5 families entirely and another 8 homesteads were eroded partially.

Table C13: Villages Affected by Erosion in June 1993

Village	Homestead			Status of affected households		
	Total	Fully eroded	Partly eroded	Took shelter in others' house within the village	Took shelter in the primary school within the village	Took shelter in another village
Radhanagar	195	3	192	3		
Sahebnagar	25	7	18	6		1
Gopalpur	18	3	15	3		
Marala	67	10	57	4	6	
Nayanagar	59	6	51	5		1
Ikrampur	31	15	16	8		7
Nichintapur	32	6	26	4		2
Sreepur	180	12	100	9	3	
Total	670	62	475	42	9	11

Source: Field observation

Table C14: Status of selected villages affected by erosion (August 1993)

Village	Homestead			Status of affected households who shifted to other places			
	Total	Fully eroded	Partly eroded	Others' house within the village	In the school	In another village	Returned to own house
Radhanagar	195	5	190	5	-	-	-
Shahebnagar	25	15	10	8	-	4	3
Gopalpur	18	7	8	6	-	1	-
Marala	67	10	57	4	6	-	-
Nayanagar	59	6	51	5	-	1	-
Ikrampur	31	15	16	8	-	5	2
Nichintapur	32	6	26	4	-	2	-
Sreepur	180	15	150	12	3	-	-
Shibpur	79	3	76	3	-	-	-
Islampur	170	12	158	11	-	-	1
Barkuri	30	3	25	3	-	-	-
Sublargaon	130	12	113	12	-	-	-
Shahaganj	55	13	42	13	-	-	-
Total	1071	122	922	94	9	13	6

Source: Field observation

Table C15: Status of selected villages affected by erosion (October 1993)

Village	Number of households who shifted to other places as their homesteads have been eroded	Number of households returned
Radhanagar	5	3
Sahebnagar	15	2
Islampur	12	5
Gopalpur	7	-
Marala	10	4
Nayanagar	6	3
Ikrampur	15	-
Nichintapur	6	2
Sreepur	15	7
Shibpur	3	1
Barkuri	3	3
Subllargaon	12	7
Shahganj	13	9
Total	122	46

Source: Field observation

C.11 TRANSPORTATION

Monsoon period

During the monsoon months, there are generally two types of transport, such as, ferry boats (country boats) and mechanised boats used for transporting both passenger and freight. The country boats are used for short distance and mechanised boats for long distance. At present there are about 80 country boats in 49 villages of Shanir Haor. In every boat, there are two boatmen. One of the two is younger who is generally a son or brother of the elder one.

Fare is based on distance. For instance, fare from Beheli to Sachna, about 5 km, is 4 taka per passenger and from Islampur, Shibpur and Chandipur to Sachna, about 6 km, is 5 taka per passenger, and so on. One country boat can earn taka 50 - 70 in one day during the monsoon.

In Shanir Haor, there are now about 13 mechanised boats which are mainly used for transporting both passenger and freight through specific routes in the haor. For example:

Beheli to Sunamganj
Beheli to Sachna
Beheli to Tahirpur
Beheli to Badaghat
Beheli to Badarpur

Tahirpur to Sunamganj
Tahirpur to Madhyanagar
Tahirpur to Bisharpasha
Tahirpur to Mohanganj

Fatehpur to Mohanganj

Post-monsoon period

During October, country boats and mechanised boats in Shanir Haor are not sufficiently available due to recession of water. As many routes are closed down, transport cost increases and it becomes very time-consuming. At the end of October, some routes are already closed. For example, service route between Tahirpur and Sachna has been stopped. The situation is same for the Islampur-Sunamganj route. Mechanised boats plying from Beheli to Sunamganj via Bishwamvarpur now follow a changed route, that is, through the river Rakti via Durlobhpur which involves more time and cost.

In November, transportation by all types of boat are almost closed throughout the Haor Area. Tahirpur-Islampur route remains functional to some extent and the fare per person is 5 taka. Besides, one mechanised boat serves the route from Tahirpur to Sunamganj and another one from Pandub to Sunamganj which ply through the river Rakti via Beheli.

C.12 SCHOOL ATTENDANCE

August 1993: During a visit to Beheli Govt. Primary School, 63% students were found present. The students come from different villages, such as, Beheli, Moshalghat, Tilkai, Alipur and Putia. Among these villages, all are in close proximity to the school except Putia which is about 2 miles away. During this period, the students of Beheli can come to school on foot and others have to come by boat.

September 1993: On 4 September in Marala Govt. Primary School, 26% students were found present. One teacher out of two was present on that day. Only the students of Marala study in this school. According to the headmaster of this school, there are some causes behind the low attendance. These are:

- due to poverty, the guardians of the students do not pay adequate attention to their children in this regard;
- shortage of boat for transportation of the students from different para of the village;

On 11 September in Shahganj Govt. Primary School, none of the two teachers was present. There were 11 students, 6 boys and 5 girls, present in the school.

On 27 September in Beheli Govt. Primary school, 25% students were present. Four teachers out of five were present on that day. One teacher stated that the low attendance of students was due to a marriage ceremony which took place adjacent to the school.

Mainly, during the rainy season the weather is often rough. That is why the guardians of the students are afraid of sending their children to school through rough weather by boat.

October 1993: On 18 October in Marala Govt. Primary School, 61% students were present. One teacher out of two was present on that day. According to opinion of the teacher, attendance of students had increased because now they can easily come on foot.

On 19 October in Shahganj Govt. Primary School, only 3 students were present but none of the two teachers was available.

C.13 TENANCY SYSTEM

In Shanir Haor there are three types of land tenancy system, such as, rongjoma, chukti, and borga.

Rongjoma
One kind of lease where the tenant or operator hires the land for one crop season and pays the rent in cash at the time of contract. Most of the contracts are made during the July-October period. In Shanir Haor, this type of lease is mostly prevails. Land-owners like this system very much.

The rate of rongjoma varies according to the quality of land. In Beheli, Shibpur, Chondipur, Moshalghat, Rajendrapur, Barunka, Fatehpur, etc., the rate per ker is 400-600 taka. In Marala, Nayanagar, Nichintapur, Shahebnagar, Ikrampur and Sripur, the rate is 300-450 taka per ker.

Chukti
The tenant hires the land for a crop season. The rent is fixed in advance but is paid after the harvest. In Shanir Haor, the rate of Chukti per ker is 2-4 maunds according to the quality of land.

Borga
Under this system, the land-owner provides land and all other inputs are provided by the operator. The produce is divided equally among the land-owner and the operator. In some cases, the land-owner gives the operator 50% seeds and fertilizers. Borga system is not popular in Shanir Haor.

C.14 GLEANING OF RICE

September 1993: On 19 September, 15 persons with 6 boats were found to be involved in collecting rice from under 3-4 feet deep water near the villages of Birnagar, Dutma and Joynagar with the help of ochu and chai. They were gleaning rice in different harvesting places and also in the khola where rice was dried during the period of harvest. Now they are getting 5-6 kg of rice per person per day.

October 1993: The number of rice gleaners increased in different places. The situation is presented below:

Table C16: Number of Gleaners

Village	Number of gleaners
Islampur	12
Shibpur	10
Chandipur	4
Nayanagar	14
Birnagar, Lakshipur, Datma	10
Total	50

Source: Field observation

They were involved in gleaning with the help of ochu form in places where the harvesters kept the bundles of rice during the period of last boro harvesting. Now they are getting about 8-15 kg of rice per person per day.

November 1993: Some poor people of Radhanagar, Islampur, Nayanagar and Shahebnagar were involved in gleaning rice from under the water in specific places of the haor with the help of ochu.

December 1993: Gleaning of rice in Shanir Haor from under the water has been stopped from the beginning of December. The persons who were involved in gleaning are now working in the agricultural field and are also fishing in the low-lying areas of the haor. Last year, low-lying lands of the Haor were not transplanted mainly due to water-logging. That is why, gleaning of rice has been stopped earlier.

C.15 IRRIGATION

In Shanir Haor, comparatively high land areas are to be irrigated for cultivation with the help of LLP. Most of the lands are cultivated with HYV and boroshail.

One LLP (power pump) can irrigate up to 15 hectares of land. The owner of the pump usually gets money or rice in exchange of water from the farmer. Some criteria are followed in this regard:

- A contract is to be made between the owner of the LLP and the cultivators of the land through mutual negotiation. Such a contract has been negotiated in Barkuri and Nayabarunka. The cultivators of these areas would pay the owner of the LLP 3 maunds of rice per ker after harvesting in exchange of water.
- The owner of the LLP would supply water according to need of the land.

- The owner of the LLP would bear all operating costs including the wage of the driver.

In Almadahar and Puran Barunka, the price for water is 2 maunds of rice per ker (0.30 acres), other conditions remaining the same.

There is another system where a cultivator has to pay the LLP owner Tk 300 per ker for one season in addition to sharing the cost of diesel. All other expenses are borne by the LLP owner. This system is found in certain areas of Nayabarunka. The number of LLP and area covered on a village-wise basis is presented below:

Table C17: Area Irrigated by LLPs

Village	No. of LLP	Area (ha)
Kiddirpur	1	8.50
Nayabarunka	2	18.21
Almadahar	1	14.97
Puran Barunka	1	14.17
Patharia	1	11.33
Anwarpur	5	59.51
Total	11	126.69

COMMODITY PRICES

Table C18: Price of different commodities in November 1993

Item	Average price/kg (Tk)	
	Village market	Thana Market
Bora Maach	52.00	56.00
Chhoto Maach	26.00	31.00
Dry Fish (Chhoto)	41.00	47.00
Egg	7.00	8.50
Duck, chicken, meat (goat)	55.00	70.00
Pulses	27.00	27.00
Rice (unhusked)	6.54	6.54
Rice (husked)	8.75	8.80

Source: Field observation

Table C19: Price of different commodities

Item	Price/kg (Tk)			
	November 1993		December 1993	
	Village market	Thana market	Village market	Thana market
Boro dhan	5.00	5.00	5.25	5.25
Shail dhan	5.75	5.75	6.25	6.25
Irri dhan	5.00	5.50	5.50	5.50
Aman dhan	5.50	5.50	5.75	5.75
Boiled rice	9.75	9.75	9.75	9.75
Atap shail rice	9.00	9.25	10.00	10.00
Murir chaul	10.50	10.50	11.00	11.00
Papaya	12.00	10.00	10.00	8.00
Gourd (per piece)	4.00	6.00	3.00	5.00
Kachkala (Hali)	4.00	6.00	3.00	3.00
Data	4.00	6.00	3.00	4.00
Radish	4.00	5.00	1.00	1.50
Bean	15.00	20.00	8.00	10.00
Brinjal	12.00	14.00	6.00	8.00
Jalpai	-	10.00	-	8.00
Potato	-	12.00	8.00	7.50
Mukhi	-	10.00	-	10.00
Puishak	-	12.00	-	8.00

Source: Field observation

APPENDIX D

AGRICULTURE DATA

APPENDIX D : AGRICULTURE DATA

INDEX

D.1 FLOOD AND DRAINAGE CONGESTION

The boro crop was reported to be damaged by flood/drainage congestion in 1992. The loss of production, however, was relatively low compared to that in the previous year. The flooding pattern in this year was reported to be comparatively favourable for rice cultivation. In 1993,the flood in February damaged boro rice at early vegetative stage. Moreover, a significant area could not be transplanted due to drainage congestion. In 1994, the boro crop was damaged by breaching of embankment. During the monitoring period, the crop damage by pre-monsoon floods was reported to be the highest in 1994. About 175 ha of local boro was damaged in Shanirowa beel (Compartment 5). The compartmental bund saved the crop from damage in other area.

People tried to collect the submerged mature rice by wooden hook (locally called aki) standing on boat. It was reported that they could collect 10 to 12 kg of rice per person per day.

D.2 WATER STRESS

Incomplete emergence of panicle in boro rice due to water stress were reported in 1994. According to the farmers, about 15 to 20% rice could not be threshed and remained with straw in some years.

D.3 SHATTERING OF RICE BY HAILSTORM

Boro was damaged due to hailstorms in 1992 and in 1994. The damages range from 60 to 100 ha.

D.4 RICE STERILITY

Rice sterility decreases production significantly. In 1994, boro yield was relatively low due to high sterility. According to the farmers the temperature was exceptionally low during the late February to the late March. This is time of panicle initiation and booting of boro rice. High sterility appeared to be due to this cool temperature at the reproductive stage. The yield of BR14 (HYV) decreased significantly.

D.5 DAMAGE BY RATS

Damages of rice by rats are increasing. It was found to be high in deepwater rice.

D.6 AGRICULTURE SERVICES

The project area is occupied by Tahirpur, Jamalganj and Biswamvarpur thanas. However, Tahirpur thana includes most of the haor. Communication is a main problem to contact farmers and conduct demonstration. Thana agriculture office do not receive enough fund for extension activities. Funds and materials do not arrive timely. Therefore, contact farmers can not receive the materials timely.

The thana agriculture office is always lacking of sufficient man power. In 1992, it was observed that less than 50% of the block supervisor had been posted or present during the year in Tahirpur thana. Only one officer out of 5 had been posted during the same period. There was one block supervisor from Tahirpur thana working in Shanir Haor.

Seed Distribution

Tahirpur Thana Agriculture Officer believes that regular and sufficient supply of seeds by the BADC can increase HYV rice production. Seeds of high-yielding and improved varieties are not sufficiently and timely available at the thana BADC. In Biswamvarpur thana about 5% of total seed requirement were distributed in 1992.

In October 1992, Thana Agriculture Officer in Tahirpur was requested by 20 farmers to supply HYV rice seeds. Thana BADC is responsible for supplying the seeds. However, they did not have sufficient seeds to supply. Jamalganj thana BADC received 5,000 Kg of HYV seeds. The office required 6,500 Kg.

Many farmers are interested for potato cultivation. But the BADC office in the thanas can not always supply the seeds. In Tahirpur there is no cold store. The BADC office requires atleast 3 days to bring seeds from the nearest seed distribution point and supply to the farmers. The seeds may start to rotten during this period and the local BADC personnel have to compensate it. Therefore, the BADC personnel show little interest to bring potato seeds. In 1992, the thana BADC office in Tahirpur indented for 1,000 kg of potato seeds. The demand was 10,000 Kg according to BADC thana seed inspector and agriculture officer. In Jamalganj thana potato seeds did not arrive in time.

For other seeds there is no problem like potato seeds. However, the seed supply is insufficient according to the demand and do not arrive timely due mainly to bad communication. In 1992,

there was a high demand of wheat seeds in Jamalganj thana, but they did not receive any. Vegetable seeds were also insufficient than the requirement.

Farmers come from long distance to collect seeds experiencing bad communication. They spend long time in their busiest season. A considerable amount of money is also required to reach the thana. When the BADC can not supply the seeds they rarely come for the second time. It was reported that there is no cold storage in Sylhet region for storing seeds. Seeds usually come from long distance.

D.7 CROP PRODUCTION CONSTRAINTS

Flooding: Early flash floods are the major problems in the project area. Flash floods in pre-monsoon damaged rice at mature stage. Embankments are breached or cut frequently. Recently there is an increase in the breaching and cut.

Drainage Congestion: Slow drainage in post monsoon season restrict the production of rice. It prevents land being made available for cultivation. Every year a considerable area could not be cultivated.

Hailstorm: Hailstorm at the time of flowering and ripening stages is a panic to the farmers. If it occur when rice start to flowering the grain can not form. All the spikelets are shattered when there is hailstorm at time of ripening. The farmers are in panic in April. In 1994, about 100 ha of boro land was damaged by hailstorm.

Weed Infestation: High infestation of weeds is an severe problem during the land preparation. This requires additional cost for clearing the land. The infestation is high in the shallow flooded lands. The infestation is low when flood occurs early. Delay in flood help in the germination and establishment of the weeds. Parua (*Echinochloa colonum*) is a major weed found in the project area. It is very lengthy with swollen nodes, few branches and leaves. The stem have a good elongation ability. A floating parua with a length of 5.6 m was observed near the Ramcharan beel in October, 1992. The propagation can take place both from seeds and by vegetative means. Delay in the occurrence of flood and gradual increase in water level are most favourable for the paura to grow well.

When flood water recedes, farmers start to clear their infested fields. The border of the land is used to pile weeds. According to the farmers, one-tenth of the cultivated land required for staking weeds when infestation is high.

Inadequate Seed Supply: Usually farmer use their own seed. Farmers are cultivating the same local varieties on the same land from time immemorial. HYV growers usually collect seeds from thana BADC when available. Some HYV growers collect seeds from their field. But their seeds are contaminated as they do not practice rouging. Sometimes they buy the seeds from the local market paying higher price. Thana office of BADC is responsible for seed distribution. However, the seed supply to this office is always insufficient. Thana BADC always receive less quantity of seeds than the requirement. Damage of crops is also followed by seed scarcity.

Renting of Lands: Small and medium farmers are forced to rent their land due to lack of fund for cultivation. The rate depends on the type of land. The rate is high in the land which can be

easily irrigated. In 1992, a farmer, who rented out a good share his land was found in Beheli. The farmer did not have enough capital to cultivate all of his land as he spent a large amount of money for the treatment of a member of his family. If he would cultivate the land, he could get about 20% more from the land he rented out. He did not try to get loan from bank because it was very difficult, time consuming and uncertain.

Advance Selling of Crops: Advance selling of crop with low price is a major constraints for small and also medium farmers to improve cultivation practices. They sell their rice before harvesting, or in many cases cultivation. In 1992, it was reported that farmers sold rice for as low as 40% of the price they could sell immediate after harvest.

Farmers go to money lenders and sell their crops in advance for different reasons. The major reasons for this advanced selling include: repairing of house, treatments, and requirement of funds for cultivation.

Low return from HYVs: According to some farmers the return from HYVs is not attractive. They tried HYVs in their fields but returned to local varieties. The HYVs need much investment and management. However, they do not get expected yields. Survival rate is low in HYV seedlings. Sterility is also relatively higher in HYVs. The farmers believe that their land is not suitable for HYVs.

Credit: Bank credit is available in Tahirpur, Jamalganj and Biswamvarpur thanas. Farmers, however, find it difficult to get the loan from the banks in time. There are many bureaucratic formalities in the banks. The bank requires many documents which are difficult to understand and manage by the farmers in time. Banks also find difficulties in providing credit to farmers due to poor recovery, particularly during the year when harvest is poor for the damage of crops by floods. Most of farmers, therefore, are dependent on money lenders.

AGRICULTURAL STATISTICS TABLES

Table D1: Impact of heavy rain during 14-20 February 1993

Village	Amount of land (ker)		
	Total	Delayed transplantation of boro	Boro crop flooded
Sublargaon	2400	562	24
Sripur	2150	445	11
Marala	504	352	18
Noyanagar	422	185	24
Jalalpur	47	11	3
Gopinather Noyagaon	360	182	14
Ramjovanpur	1620	555	162
Mahmudpur	96	24	
Sahebnagar	492	216	24
Pandrup	124	12	
Old Moshalghat	1500	138	24
Shibpur	880	274	32
Chandipur	785	315	23
Radhanagar	3300	1255	365
Ekrampur	480	185	24
Total	**15160**	**4711**	**748**

Source: Field observation by NERP Socioanthropology team

Table D2: Areas under t.aman: December 1993

Village	Area (ha)
Fatepur	0.36
Nayagaon	1.45
Raingaigarchar	8.74
Lakha	7.28
Alamdahar	5.82
Alipur	11.65
Mahmudpur	11.65
Puran Barunka	29.14
Tiyar Jalal	21.86
Pathari	7.28
Lohachura	1.45
Anowarpur	42.10
Nayahat	1.4
Fazilpur	5.82
Dakhwinkul	39.67
Hossainpur	7.28
Chiksa	21.86
Total	**224.86**

Source: Field observation by NERP Socioanthropology team

APPENDIX E

FISHERY FIELD NOTES

APPENDIX E : FISHERY FIELD NOTES

INDEX

E.1 WATER BODIES

The project area is bordered to the north and west by the Baulai River, to the east by the Rakti River and to the south by the Nandia Gang. At the northeast corner of the area, the Baulai and the Rakti branch off the Jadukata River; the Baulai eventually falls into the Surma River below Jamalganj. Recent sedimentation at the Baulai and Rakti offtakes from the Jadukata has caused both the Baulai and Rakti to dry up in winter. In particular, Dhamalia River dry season flow, which used to pass through the Rakti, now passes through a channel to the west of Angurali Haor and subsequently into Nandia Gang. The increase in Nandia Gang dry season water levels tends to delay post-monsoon drainage of the project area. Also as a result of the sedimentation, Baulai and Rakti monsoon flood flows have also decreased, though some of the Dhamalia flood peak does pass through the Rakti. In turn, the decreased monsoon flood flows allow (i) more Surma backwater in the Baulai, and (ii) greater sedimentation in the Baulai and Rakti channels, and at the Rakti outfall into Nandia Gang. The channel capacity of the Rakti has decreased substantially. Local people believe that water levels in the rivers surrounding the project have risen due to sediment deposition, causing flooding and post-monsoon drainage congestion in the area, and increasing the incidence of embankment breaching and overtopping.

Ammakkhali Khal is the deepest khal of Shanir Haor. Most of the water in the khal drains out each year during the late monsoon (kartik) through a cut in the embankment made by the local people. Ammakkhali Khal is connected with Sonatala and Naiaduara Beel. Most of the fish try to swim out from the beel through this khal. Ikrampur khal and Jalalpur khal in the western part of Shanir Haor are closed off by the embankment. The local people are allowed to catch fish from May to July when only PUNTI, GONIA, LACHU, BAIM are abundant. The lessee harvests the fish in two phases: 1) August to December and 2) January to March. Fish production is said by the local people to have declined by 80- 90 % after completion of the embankment. Shahebnagar, Kamdebpur, Hizla and Herarkandi are the important fishing villages in Shanir Haor.

There are number of duars within the Shanir haor area in the Abbua/Putia River. Duars are used as overwintering ground by larger size fish within the area.

Information on jalmohals in Shanir Haor is given in the following tables:

Table E1: Leasing of Jalmohals

Name*	Location	Area (ha)	Thana	Fishery Type
Boigani canal P1	Near SG	6.91	Taherpur	Boigani Group Fishery
" " P2	Next to P1	8.56	"	"
Pashbhanga beel	Boigani Gr	21.47	"	"
Ramcharan beel	"	8.87	"	"
Chapachatal beel	"	19.25	"	"
Hatubhanga beel	"	26.32	"	"
Dinaram Chapati B	"	19.26	"	"
Katkatia beel	"	70.23	"	"
Tulibari beel	"	10.81	"	"
Kaijer beel	"	23.20	"	"
Ahmakkhali	"	0.58	"	"
Bora beel(3501)	N/E of Boi	14.17	"	"
" " (3701)	"	113.49	"	"
" " (4193)	"	8.52	"	"
" " (4140)	"	1.805	"	"
" " (4246)	"	2.30	"	"
Sonatola (1449)	E. Marala	31.94	"	Single fishery
" (2152)	"	52.77	"	"
Dhawa beel	W.Dhawa V.	22.62	"	"
Cosma beel		7.21	"	"
Chander doba		0.51	"	"
Sukurbander doba		0.89		
Purba dober beel		1.0		
Boicherdoba		0.82		
Chhatardoba		1.90		
TOTAL =		475.41		

*All these jalmohals are leased by Md. Abdus Salam of Sunamganj for the period from 1392 to 1401 B.S. (1984-85 to 1994-95).

Table E2: Information on Small Beels of Shanir Haor

Name of beel	Address of lessee	Yearly lease (Taka)
Shaniroya beel	Md. Faruq Miah Vill. Radhanagar	30,000 (for 3 years)
Putichora beel	Md. Dud Miah Sunamganj, Md. Nuruzzaman Radhanagar	30,000
Atla beel	Md. Makhlesur Rahman Vill Radhanagar	5,000
Shingraghat beel	Md. Ukil Miah Vill. Daoya	40,400
Daoya beel	Md. Nuruzzaman Vill. Daoya	60,000
Digha beel	Mr. Muksud Ali Vill. Puran Moshalghat	23,000

Source: Field observation

E.2 MONITORING OF ENVIRONMENT

Temperature

Noon-time air and water temperatures recorded during sampling work are presented in the table below:

Table E3: Air and Water Temperatures

DATE	TEMP (°C)	
	AIR	WATER
15 Jul 92	30	28
16 Jul 92	28	27
17 Jul 92	30	28
18 Jul 92	30	28
10 Aug 92	32	30
12 Aug 92	35	34
15 Aug 92	36	34
14 Sep 92	30	28
15 Sep 92	30	29
16 Sep 92	30	28
17 Sep 92	30	28
27 Oct 92	29	28
28 Oct 92	29	28
29 Oct 92	31	29
30 Oct 92	33	31
01 Nov 92	31	30
02 Nov 92	32	30
03 Nov 92	33	30
04 Nov 92	32	30
05 Nov 92	33	30
06 Nov 92	32	29
07 Nov 92	30	28
08 Nov 92	26	28
21 Jan 93	18	15
22 Jan 93	19	16

DATE	TEMP (°C)	
	AIR	WATER
23 Jan 93	17	13
02 Mar 93	27	23
03 Mar 93	28	25
06 Mar 93	29	26
07 Mar 93	30	26
08 Mar 93	29	25
11 Apr 93	25	26
12 Apr 93	26	26
24 Apr 93	30	28
25 Apr 93	28	27
27 Apr 93	25	25
30 Apr 93	27	27
11 May 93	27	27
12 May 93	27	27
13 May 93	39	28
14 May 93	30	29
15 May 93	31	30
17 May 93	26	25
14 Jun 93	30	29
16 Jun 93	26	27
17 Jun 93	25	27
19 Jun 93	27	28
20 Jun 93	26	26
23 Jun 93	31	29
25 Jun 93	31	29

Table E3: Air and Water Temperatures (Cont'd)

DATE	TEMP (°c)	
	AIR	WATER
26 Jun 93	28	29
16 Jul 93	29	30
17 Jul 93	30	29
19 Jul 93	27	27
21 Jul 93	27	27
24 Jul 93	29	30
26 Jul 93	30	30
27 Jul 93	29	30
28 Jul 93	30	29
14 Aug 93	31	30
16 Aug 93	30	30
19 Aug 93	31	30
21 Aug 93	29	28
14 Sep 93	33	31
16 Sep 93	32	30
19 Sep 93	32	30
18 Nov 93	27	28

DATE	TEMP (°c)	
	AIR	WATER
26 Nov 93	28	27
14 Dec 93	28	26
15 Dec 93	28	27
16 Feb 94	28	26
17 Feb 94	26	23
16 Feb 94	30	28
25 Mar 94	24	25
26 Mar 94	22	24
27 Mar 94	18	20
28 Mar 94	27	26
29 Mar 94	28	27
23 Apr 94	32	30
24 Apr 94	31	30
25 Apr 94	33	31
08 May 94	33	31
09 May 94	34	31
10 May 94	29	28

Hydrology

The hydrological data of Shanir Haor shows a different water level status in different places during early monsoon depending on water inflows to the haor. NERP hydrological data recording system started during the third week of May 1992 when the water level in the riverside was 1.5 m above the haor side in Marala, while 0.8 m above in Taherpur. The hydrology data also indicates the higher water level both in the River side and haor side near Taherpur region than the Marala upto mid June, though Taherpur region is more important for agriculture while Marala region for fisheries. Water level both in the haor and the river side shows more or less same level from late June to December. The Submersible embankment around the haor overtopped during the late June. Total area of embankment was under water upto end of October.

April-May is the crucial important period for fish when most of the inland fishes migrate from over-wintering ground (permanent deeper water body) to newly inundated shallower region. Brood fishes migrates for breeding to the spawning ground, usually carps prefer shallower region having better grazing scope for breeding. Young fishes migrated for grazing.

Monsoon is the main growing period of fish. During early monsoon started with the first flash flood fish become maximum active in swim to find their best grazing and spawning ground. Any barrier in migration route during this period makes them easier to exploit.

In the Shanir haor migratory fish in the rivers cannot enter the haor before late June. Shanir haor was one of the important fishery within this region. In 1992, cutting of the embankment occurred on the following dates, and at the following places:

YEAR 1: May 1992 - April 1993

18th May 1992: (1) at Shaniroa, south of Radhanagar. The cut was made by four men from Radhanagar who sub-lease a beel just inside. Their aim was to catch fish then, but also to create a canal which will become good fishing ground at the end of the monsoon as water reduces.

18th May 1992: (2) near Tilkhoi. This cut was likely made by non-traditional fishermen to catch fish during the spawning season.

28th May 1992: (3) just north of Marala. A cut was made again for the purpose of catching fish.

This information helps to interpret the water level graphs. Included is a map which with the names of villages and location of cuts.

Monthly hydrological observations were as follows:

January 1993: Most of the beel and agricultural land were ready for harvest and cultivation respectively during the 1st week of this month. Due to rising of water level (about 1 m in the southeast region and 0.5 m in the southwest) in the river (during 7 - 8 January) whole haor bed flashes about 25 cm above causing damage of agricultural seed bed. Sowing of seeds and annual bill fishing will delay about three weeks due to this flashing which may be a threat for next year rice production.

February-April 1993: The hydraulic nature of the region shows two major changes during the dry season, which did not allow usual fishing. The very early flash flood during 1st week of January made the delayed fishing and next early flash flood during 18-26 Feb. creates trouble to normal fishing. This overall changed situation will provide better scope for monitoring during this year.

YEAR 2: May 1993 - May 1994

May 1993: Early flash flood inundated the haor 1 month earlier than other year. Flood water overtopped about 80% of embankment within 10 May. The early inundation damages some paddy but it might be cause of better production during this season.

June 1993: The hydrology of this month is the exceptional one than the same month of other previous years. The villagers residing over middle and western part of the haor are suffering greatly by the large wave action. About 25% of the homestead of Marala, Alipur, Rajdharpur villages lost their houses due to severe erosion during the 2nd and 3rd week of the month. The fishermen community also effected in same manner. The fishing activity seems to be greater than the last year though the weather is not favourable to fish over the haor. The average market price of the fish observed lower than the last month.

July 1993: Heavy rainfall and strong waves creates severe problem to the fishermen community. Huge number of fisheries lost their house as well as they can't fishing in the Haor area due to strong wave. The scope of fish catch reduced remarkably during this period. Some big fish were caught inside the Haor area are the main message during this reporting period. Sudden water raising during the 3rd week changes the regular Haor life.

August 1993: The water level during this month is higher than the same month of previous year. The average fishing activity was dropped during the 1st half of the month due to the national Fish fortnight program. Rough weather with heavy rain makes difficulties on fishing activity in the haor area. Some endangered species were also caught during this month. Fish prices was observed to be increased during this month.

September 1993: Overwintering migration of fish was the main feature during this reporting period. A good number of fish were caught from the river and canal during the overwintering migration. Fishermen community leads a better life during the period as they can fish more. The weather as well as the water quality was better than the previous month. People assume that the fish production will be greater than the last year.

November-December 1993: In general fishing activity dropped down due to receding of water level. Most of the non-traditional fishermen engaged in agricultural work. The lessee of different beel are getting preparation for beel fishing. Beel fishing in small shallow beels were started during the 1st week of December. Fish marketing controlled in some particular places, dry fish are dominating the local markets. Traditional fishermen are fishing in the riverside.

January 1994: Beel fishing started during this month. A group of fishermen were hired from Lakhai thana for harvesting fish. Fishermen arrived earlier and developed their homes facilities to stay over there for total fishing period. The Management group are also residing over there. Major fishing in the small shallow beels were completed during this month.
February 1994: As the reporting period is the peak season for beel fishing most of beel fishing have been taken place. Due to proper drainage effective beel fishing takes place than the last year. A good quantity of fish also caught by the poor fishermen from the out side shallow area of the Haor separated from the beel during this period. It was observed that around one metric ton fish have been catching everyday. Large fish caught from Boigani Gr. Fishery are directly transported to the Dhaka by Cargo. The fishermen movement in the Khola seems to be lively during this month.

March-May 1994: Water level increases rapidly from the 3rd week of March. Though main Haor area protected from the flash flood but the southern part could not protected due to a breach created near Sonarua beel adjacent to Radhanagar. No major change was observed during April-May.

Water quality

During monitoring work it was not possible to analyze all the parameters to determine the productivity level. The over all water body of Shanir haor was observed more or less better during the full monsoon than both of late and early monsoon. The haor receives flash water in the early monsoon through some public cuts and mainly by the sluice gates by which the haor suffers less siltation problems. This situation provide less scope for nutrient release to the environment as well as limited the major water exchange facility. During full monsoon the haor merge with all other adjacent haors, rivers etc. attaining a sea like basin providing a unique

habitat for aquatic organisms. In the late monsoon water can not drain out immediately due to less draining facility, and higher river bed caused by the excess siltation providing more water hectarage period within the haor.

YEAR 1: May 1992 - April 1993

January 1993: The greenish water of the beel seems to be better productivity for fish though the fish food consumption is less due to low temperature.

February-April 1993: Water quality of the beel was clear throughout the period due to stagnant water. The river water was turbid and higher.

YEAR 2: May 1993 - May 1994

May 1993: The spill water makes the haor turbid mainly adjacent to the embankment. The flash flood water entering through the public cuts and natural breaches also makes the haor water turbid. The northwest part of the haor and the haor periphery were turbid. The main depression and the southwest part were clear.

June 1993: Due to heavy rain fall and strong wind during the early fortnight of the month, the water level increased rapidly. Strong wind causes waves in the haor water resulting in turbidity. A number of homesteads of different villages were destroyed due to erosion of supporting land of the house caused by high waves. During the last two weeks the water was comparatively clear than it was before.

July 1993: Heavy rainfall with strong wind makes the shallow area turbid mainly adjacent to the village. The water level rises about 30cm during this month and a number of houses in the south western villages damaged severely due to erosion caused by the strong wave action. Water was flowing from east to west.

August 1993: The water was clear during the 2nd and 3rd week of the month. Due to heavy rainfall with rough weather water was very turbid during the last week of the month. The water level receded slowly during the whole month.

September 1993: The water looks more clear during this reporting time than the previous year throughout the Haor. The water level was reducing rapidly draining from the east through the southwest part of the Haor.

November-December 1993: Water in the shallow area and in the isolated beels are little turbid due to fishing and agricultural activity in the adjacent higher land. Water in the main depression is clear.

January 1994: The river water was turbid as a lot of boats loaded with sand are moving through the rivers. Water in the beels was good though the fishing activity was continuing.

February 1994: Regular fishing activity in the beel area creates turbidity for the time being. The water level receding at the lowest level compared with the last few years.

Findings on water quality in the haor are summarized in the following table:

Table E4: Water Quality

Year	Month	Haor Periphery	Main Depression	North and Northeast Part	Southeast Part
1992	J	Turbid	Turbid, Clear	Muddy, Turbid	Turbid, Clear
	J	Turbid	Clear	Muddy, Turbid	Clear
	A	Turbid,	Clear	Muddy, Turbid	Clear, Green
	S	Clear	Clear, Green	Greenish, Clear	Clear, Green
	O	Clear	Clear, Green	Greenish, Clear	Clear, Green
	N	Clear	Clear, Green	Greenish, clear	Clear
	D	Muddy	Green	Greenish, clear, Turbid	Turbid, Muddy
1993	J	No water	Green	No water	No water
	F	No water	Green	No water	No water
	M	No water	Green	No water	No water
	A	No water	Clear	Low water level	Low water level
	M	Turbid	Clear	Clear	Turbid
	J	Muddy	Turbid	Turbid	Turbid
	J	Turbid	Turbid	Turbid	Turbid
	A	Turbid, Clear	Clear	Clear	Turbid, clear
	S	Clear	Clear, Greenish	Clear, Greenish	Clear, Greenish
	O	Clear	Green	Greenish	Clear, Greenish
	N	Clear, Turbid	Green	Low Water level	Low water level
	D	Turbid	Green	No water	Water in beel
1994	J	No water	Green, Turbid	No water	No water
	F	No water	Turbid, Greenish	No water	No water
	M	No Water	Turbid, Greenish	No water	No water
	A	No Water	Green, Turbid	Low Water level	Low water level
	M	No water	Green	Low water level	Low water Level

Aquatic plants
Common aquatic plants in Shanir haor are:

Table E5: Common Aquatic Plants

Local Name	Scientific Name
Shaluk	Nymphaea nouchalli
Khoierpani	Aponogetom natans
Shapla	Nymphoides indica
Paura	Brachiaic subquadripas
Pislabon	Lagaronsiphon roxburghi
Lakely	Hydrilla verticillata
	Potamegeton
Jhaobon	Najas graminae
Lakhma	Limnophila sessiliflora
Katajhanji	Ceratophylum desmersum
Kaisa	Lagarosiphon rosburgii
	Myriophylum tuberculatus
Panikola/ kaorali	Ottelia alisonoides
Patasheola/ Bicha	Vallisnaria crassipes
Chhota jhanji	Utricularia exoliata
Phutki	Hygroryza aristata
Karpur	Leinnophila indica
Nil shapla	Nymphaea stellata
Rakta/sada shapla	Nymphaea nouchali
Chandmala	Nymphoides cristatum
Erali	Pseudoraphis spinescens
Singra/ paniphal	Trapa manimowiezii
Helencha	Alternanthera philoxeroides
Kalo keshi	Eclipta alba
Kolmi	Ipomea aqutica
Dhol kalmi	Ipomea fistotisa

The northeast part to mid-south part were high in aquatic vegetation. The northeast part of the haor was densely populated by Paura bon during whole monsoon due to compartmental bund. The western part of the haor is relatively free from aquatic plant.

During 1992 monsoon it was observed that the northeast part and half of the southeast part were densely covered by the aquatic plants. Northeast part was highly populated by the Paura bon due to less drainage scope caused by the compartmental bund. The western part of the Haor was relatively free from aquatic weeds than the other area. But in 1993 monsoon very few aquatic plants were observed even in the northeast part of the Haor. Sudden increased water level did not allow more aquatic plants to grow in the Haor resulting in a better habitat for fish during this season.

YEAR 1: May 1992 - April 1993

January 1993: Aquatic plants are observed only in the beel area. Farmers engaged labor to remove the aquatic plants from their land for agriculture. As the northeast area was covered by dense aquatic weed (Paura) during monsoon farmers needs more money for preparing their agricultural land.

February-April 1993: Due to increased water level, some aquatic weeds are growing in the shallower (new inundated area) region around the beel.

YEAR 2: May 1993 - May 1994

May 1993: Due to sudden inundation and turbid water it was not possible to identify the aquatic weed status throughout the haor.

June 1993: Due to sudden inundation of water causing turbidity, it was not possible to identify the aquatic weed status throughout the haor.

July 1993: Due to sudden inundation and turbid water the Haor seems to be mostly free from aquatic vegetation but in the northeast region of the Haor there were some aquatic plants.

August 1993: There are fewer aquatic plants than last year. Some plants like Paura, Erali and Putki were observed in the deeper part of the Haor while Jao and Shapla were observed in the shallow region.

September 1993: Because of declined water levels some aquatic plants were visible mainly in the shallower part of the area. Northeast part of the Haor was more dense than the other area. Paura, Erali and Putki are the main plants in the northeast region while Arali, Jhanji, Shapla, Khoierpani and Jhaoban are dominating in the eastern part. But in comparison with the same period of the previous year aquatic plants are less.

November-December 1993: Aquatic plants are not very remarkable during this year in comparison with the last year. In the northeast region the Paura bon was not prominent like last year. In Dhawa beel area some Khai and Singra plants were observed.

January 1994: Due to rapid dropping of water level and turbidity aquatic plants were not visible in the shallow area. In the deeper area some Singra, Erali and Chailla were observed but it was very few in number.

February 1994: Some Singra and Chailla were observed to grow in the shallow region of the beel.

E.3 MONITORING OF FISH STOCKS

Fish abundance based on catch assessment surveys

General aspects of fish abundance and project impacts

Shanir haor was once one of the most productive fisheries in the region, but has lost productivity due to natural and development factors. Siltation in the Baulai river located in the north and south side of the haor is increasing and depresses fish production. The surrounding embankments have only a single inlet/outlet structure (Boigani regulator) which does not allow migrating fish (broodstock, juveniles, fry) to get in during early monsoon. This results in heavy fishing mortality of brood fish during the breeding migration (*uzaia utha*) in April/ May in the shallower beel area because of public cuts in the embankment. Delayed migration is also due to the embankment. It was observed that only a very few migratory species were found within the Haor area after early inundation (May - June). One RUI (13cm/ 22gm) fry was caught (1st catch of the year throughout the haor) at 16 July 1992 in Rongerchor (adjacent west side of eastern embankment of Shanir haor) and two gravid female RUI (37.5cm, 2.1kg ; 43.0cm, 2.8kg) were caught in August 1992 near Islampur.

Local old people (including fishermen) mentioned that fish abundance has suffered a major decline (90%) over the last 20-25 years. The following reasons were said to play an important role in the gradually declining fish production:

- New recruitment into the fishing profession, who do not care for future production, but only immediate benefits from exploiting the resource.
- Most of the river beds silted up due to: 1) erosion/wash out of BWDB embankments very close to the river, and 2) natural siltation causing problems to fish migration.
- Siltation of beel beds causing decreased water volume and water hectarage.
- BWDB embankment causes late inundation of the beels, limiting fish growing season.
- Use of illegal gears (KONA JAL, CURRENT JAL)
- Brood fish and fry /fingerlings harvested by the people.
- Deforestation within the haor area.
- Substitution of pile fishing system by annual fishing system causes the decrease of large brood fish.
- Dewatering of beels for fishing.

The nearby Tangua haor, with its favourable environment functions as the mother fishery or the "heart" of the fisheries resource of this area. This suggests that because of its proximity, fish abundance in Shanir Haor may be in part controlled by fish abundance in Tangua Haor in any one year. Fishermen of this area clearly mentioned that present year fish production (Year 1) would be less due to delayed monsoon, less inundation and short inundation period.

Compared with the previous year, fish production declined 30-40% in 1992-93 due to delayed monsoon and lower water level. In 1991-92 local fishermen harvested KHORA (23-30cm RUI, average weight around 300 gms) during this particular period (August). In 1992-93 most of the RUI are below 12 cm due to delayed monsoon and less water level. Compared with previous years, water level is very low, so fish can be caught easily in some particular area. Due to the delayed monsoon, the size of fish is relatively smaller than the other years, so they are easily harvestable by small meshed current net (which may seem to be increased production). Due to less flash flood water (less Ghola) and the absence of strong current, hatchling (late spawning) survival may be high. In 1992-93 the fishermen used increased numbers and sets of gear by which they caught more fish.

The declining status of fish catch (based on interviews) are shown in the following table:

Table E6: Fish Catch Data

Gear	1991 Yields	1992 Yields	Increase in Market Price (Tk)	Remarks
KONA JAL	2 - 7 kg/ set	0.5 - 5 kg/ set	10-20%	No of gear units increased by 10-15%
HOOK & LINE	15-20/100 hooks	8-15/100 hooks	25-40%	No of gear units decreased due to low fish abundance
CURRENT/FOOT PAIN NET		less than 25% decrease	25-40%	No of current nets increased; fish size smaller

Based on the fishermen experience, the following are the preference habitat of different fish within the Shanir haor area:

Table E7: Fish Habitat

Beel/Haor	River
Catla, Rui, Mrigel, Ghonia, Kalibaus, Boal, Ghagot, Shoal, Gazar, Lati, Pabda, Kaikka, Puti, Laso, Koi, Singi, Magur, Bheda, Fali, Chanda, Icha, Chiran, Tengra, Gulsha, Kholisha, Chata, Darkina, Mola, Sarputi, Bojori, Baim, Chella, Chapila, Guzi, Golda.	Chital, Air, Ghagot, Boal, Kalibaus, Catla, Rui, Mrigel, Pangas, Shilon, Bacha, Gaura, Gulsha, Pabda, Rani, Poa, Baim, Batashi, Kajuli, Baashpata, Ilish, Baghair, Rita, Gang Magur, Gagla, Mohashol, Golda chingri.

Out of those species PANGAS, MRIGEL, BATASHI, KAJULI and ILISH are rare in the area. NANID, MOHASHOL and BERKUL are more or less locally extinct.

Near Mohammadpur village a large bend in the Baulai River has created an extensive shallow area. Large concentrations of birds over this area suggest a high fish abundance and possible fish breeding grounds. Similar bends exist in the Patlai River near Laximpur.

Beheli fishermen state that previously there were large numbers of Pangas, Mohashoal. Nandina occurred in the area, but at present these species are very rare. Generally the cost of management (pile) of a fishery is same as the cost of lease. Normally during harvesting,

fishermen could got 30-40% share of the catch. The main reason for the decline in fish are use of fine meshed net, Current net, annual harvesting in case of pile fishing and siltation.

Near Badarpur village, a fishermen named Shamsul Huq (Kharajal operator) stated that he is one of the sub-lessee of the area. At present mainly Chapila and Tengra occur in the river and his daily average sale is Tk 30-50. He mentioned that in the peck season he could sale Tk 200-250 per day.

Shanir haor has been subdivided into four main compartments by low elevation bunds. The purpose is to retain residual flood water and post monsoon rainfall to irrigate boro in the higher elevation compartments (ie NW, NE and SE) and to keep it from draining away into the lowest elevation compartment (ie SW). The bunds seem to have had a significant and unintended ecological effect on the NE compartment. It is now thickly covered with the emergent aquatic grass PAURA, and there is a lush growth of many species of floating and submerged aquatic macrophytes. [A wetland heaven, with lots of aquatic birds and all kinds of fish.] Local people mentioned that after the construction of the compartmental bunds this type of vegetation is found every year in the NE compartment because it does not drain completely during the dry season. There is a conflict between farmers inside the NE compartment (who would like to cut the bund to drain their land) and farmers on the other side of the bund (whose land would then be flooded and whose crops would be damaged).

Monthly changes in fish abundance

YEAR 1: May 1992 - April 1993

June 1992: Observations were made on fish abundance in different parts of the haor. During the early monsoon fish are most abundant in shallower regions where water is relatively stagnant and rich in food. The catch of Line fishing was 1 kg/100 hook near Taherpur, compared to 0.3 kg/100 hook in the Boigani group fishery area. The catch of kona jal (banded item) in shallow stagnant water near a village or embankment is more than ten times (4-7 kg/ 150 meter of net) that from the deeper open area (0.4-0.6 kg /150 m of net). The average catch per set is 6 kg/150 m net(average size of fish is 0.33 gm). One group of fisherman(5-8 individuals) can carry out 6-9 sets per day. There about 15 groups of fisherman within Shanir haor who catch about 0.7-0.8 metric ton of fry per day. Lati, baim, pabda, tengra, singhi(very few), mola, kaikkya, chanda, chingri, chela etc. were the main fish.

July 1992: Shallower stagnant bushy areas had a higher fish abundance. Some catfish, snake headed fish are abundant in deeper region. In comparison to the last sampling period the catch was declined while the average size of individual fish increased. Due to overfishing by mosquito netted KONA jal, the local authority restricted it's use following the Fish Conservation Act, though some gears were found in operation during our sampling period. Among all the species tengra dominated the catch (Chai fishing) by number, others species were mola, chela, punti*, kaikkya, lachhu, chaitya, tengra, chanda*, icha, bacha, anuli, potka, rui, baila, bheda(meni), naptini, baim*, chapila, kechki, gonia, lati(taki), boal, rani, kalibaus, cherain, ek thoitya, darkina, pholi, shinghi, pabda*, gulsha, unknown fry (preserved for study). In comparison with previous years the water level is 1.5m below (during July). Local people are assuming that the fish abundance will be less than the previous years. They also mention that at present both the fishing rate and catch rate are 50% lower than the last year while the catch of Lati fish is 4 to

6 times higher, which indicates the improvement of Ulcerative Syndrome disease. The size of fish is smaller compare with the previous year.

August 1992: Due to continuous decrease of water level, CPUE had increased. Most common species were tengra, kaikkya, chanda, chela, mola, punti, bata, rani, chapila, potka, baila, chingri, baim, kalibaush (12.5 cm up to kg),, Gonia (av.0.4 - 0.7 kg), Cherain, kolamuchari, rui (12.5 cm up to 3 kg), Baluchata (scientific name unknown), pabda, boal, lati, air, singhi, pholi, bheda, koi (only abundant in the eastern part) and lachu. One specimen each was observed of catla and ilish.

September 1992: Several changes were observed in fish species abundance compared to the previous month. These are noted in the following table:

Table E8: Change in Fish Abundance (September 1992)

Increased Abundance	Decreased Abundance	No Change	Rare
RUI	GONIA	KALIBAUSH	MRIGEL
BAIM	PABDA	KAIKA #	CHITAL
GULSHA	MOLA	PUNTI #	GAURA
BACHA		TENGRA # *	
GUIZA		CHAPILA +	
CHELA #		LATI	
SHINGI		BEDA	
KOI ^			
BOAL "			
FOLI			

\# Mature * Bazari tengra + School of mature fish
^ Sudden increase " Immature

The abundance of KALIBAUSH is remarkably more than last year but the size is less than at the same time last year due to the lateness of flooding and spawning this year (ie the fish are smaller because they have had less time to grow this year). Also, the size has changed little since last month, indicating very slow growth. A few RUI (around 9") were caught during this month. RUI abundance is negligible compared to the previous year. Fishermen expect low overall catches this year because of the late flood. BOROMAACH might require an extra year to mature before they can spawn for the first time.

The present CPUE of different gear used by the fishermen are given below:

Table E9: Present CPUE of Different Gear

Gear	Specifications	CPUE (kg /set)	Standing Crop (kg / ha)	Set Time
KONA JAL	100m long x 6m high	2.0	16.7	15 set /day
CURRENT NET	80m long	1.32		8hrs /day
LONG LINE	100 Hooks	0.24		over night

The CPUE of KONA JAL was estimated on the basis of the average catches of one KONA JAL operating near Taherpur and one near Islampur on 21-22 Sept 92. The average number of sets per net per day was 15. At a CPUE of 2.0 kg/set, the daily production estimate per net during this period is 30 kg. Apparent nominal standing crop estimates for kona jal were calculated using an assumed area swept. A 100m kona jal would encompass a perfect circle with an area of 796 sq m. It is estimated that the area swept by one haul was about 1200 sq m (= 0.12 ha). This figure was used to calculate the apparent nominal standing crop from kona jal catches. The CPUE of CURRENT NET was estimated on the basis of the average of 5 random catches from 5 different area at 4 different dates. Though CURRENT net is not a legal fishing gear, everyone use this frequently and also openly sold in the market by weight (1 lb = 80m approx.). Generally nets are set in the evening and lifted out in the early morning. Some nets are also set in the morning and lifted out in the evening (some of them change the place for more catch). The CPUE of LONG LINE was estimated on the basis of the average of 3 random catches from 3 different places at 3 different dates. In every catch ICHA was the bait and the line were left over night. Subsamples were taken from the KONA JAL catches from Taherpur and Islampur. Catch species composition (by weight) and length for the subsamples are given below:

Table E10: Catch Species Composition at Taherpur

Species	WT (gm)	%	TL (cm)	
			Min	Max
PUNTI	140	38.4%	6	8
KAIKA	70	19.2%	17.5	24
TENGRA	70	19.2%	4	6
CHANDA	30	8.2%	1.5	7.5
CHELA	20	5.5%	6	7.6
RANI*	5	1.4%	-	6.5
ITCHA	5	1.4%	2	6.5
TIT PUNTI	10	2.7%	2	3.5
TAKI	15	4.1%	-	7.5
TOTAL =	365	100%		

* Only one specimen

Table E11: Catch Species Composition at Islampur

Species	WT (gm)	%	TL (cm)	
			Min	Max
PUNTI	75	28.2%	5	7
CHANDA	50	18.8%	2	6.5
FOLI*	30	11.3%	-	17
CHELA	20	7.5%	4	8
CHIRAIN*	20	7.5%	-	12.5
BAIM*	20	7.5%	-	18.5
ITCHA	15	5.6%	3	5.5
TENGRA	10	3.8%	4	4
RANI	10	3.8%	6	7.5
TIT PUNTI	6	2.3%	3	3
KAIKA*	5	1.9%	-	17
POTKA*	5	1.9%	-	7
TOTAL =	266	100%		

* Only one specimen

October-November 1992: Observation of fish abundance become more difficult due to:

- control of in general over fishing by paharadar,
- dropping of water level and
- decreased area for fishing.

During this period the water level of the Haor is receding rapidly although the water level of the haor is 0.5 - 0.8m above the level last year. Most parts of the embankment around the haor are about 0.5 - 1.0m above water level. Fish were observed to be moving from the shallower to deeper areas as well as from free area to bushy area for over wintering. Most fishing were taking place in the paura bon. Based on some interviews with fishermen, cursory observation, fish market survey and NERP sampling we observe the following status on fish abundance:

Table E12: Changes in Fish Abundance (October - November 1992)

Increased Abundance	Decreased Abundance	No Change	Rare
BAIM	LACHU	RUI	CATAL
BATA	GHUTUM	GONIA	MRIGAL
LATI	PABDA	KAILA	GHAGLA
KOI	LAIA	RANI	SARPUNTI
SHINGHI	CHIRRAIN	KAIKKYA	
FOLI	ELONG	SHOAL	
MOLA	BACHA	GOZAR	
TENGRA		BOAL	
CHAPILA		CHANDA	
PUTI		GULSHA	
BAILA		AIR/GHAGOT	
KEKCHI		CHELA	
EK THOITTYA			

Most of the fishing is in the eastern part of the haor within or around the PAURA bon in the Northeast compartment. It was observed that the size of most of the fishes has increased significantly compared with last month. But the growth rate this year for major carp is still less than last year.

Except in the Sibpur Chandipur area (including north of Islampur and Puran Moshalghat, Around Beheli, some shallow part of the Haor) KONA JAL fishing has completely stopped. It was observed that only 8(7+1) KONA JAL fishing groups from Chandipur/ Shibpur are operating within Shanir haor. The fishermen mentioned that the fish catch has declined by 25% compared with one month before (it is seems, due to the over exploitation in this particular area). The average CPUE of the Kona Jal was 1.33 kg/set. The CPUE (kg/set) of Kona Jal (125m * 7m) by the different groups are given below:

Table E13: CPUE of Kona Jal

Net No:	No of Sets	Total Catch (kg)	CPUE (kg/set)
1	5	3.00	0.60
2	4	12.00	3.00
3	4	3.50	0.88

The second group of fishermen are the oldest and most skilled fishermen. The first group and 3rd group entered into the fishing only a few days before with an old net.

January 1993: No subsistence fishing was observed in the beel area. Most of the beel and agricultural land were ready for harvest and cultivation respectively during the 1st week of this month. Due to rising of water level (about 1 m in the southeast region and 0.5 m in the southwest) in the river (during 7 - 8 January) whole haor bed flashes about 25 cm above causing damage of agricultural seed bed. Sowing of seeds and annual beel fishing will delay about three weeks due to this flashing which may be a threat for next year production. Only some shallow beel fishing started. In the Tilkhoi fishery (part of the Beheli river adjacent to the Beheli village) we monitored the Khata fishing on 22 - 23 rd January 1993. Major species were boal, air, gagar, shoal, rui, pholi, kalibaush, gulsha, chela, mola, chanda, lati, koi, elong, baim, punti, gonia, lachu, punti. It was mentioned by the local people CHITAL and PABDA are available in the Sonatola beel area. Observation on fish abundance status in Shanir haor during study period are shown in the following table:

Table E14: Fish Abundance

Water Area	Pre-monsoon	Monsoon	Autumn	Winter
Shallow bushy	High	Medium	Medium	Nil
Shallow open	Low	Medium	Medium	Nil
Deep	Low	Low	Medium	Very high

February-April 1993: Fish are abundant only in the beels, where only fishermen hired by the lessee are allowed to fish. It was observed from March that most of the fishes are caught by local people when fish try to migrate (uzaia) towards shallow region (Islampur, Shibpur, Chandipur, Radhanagar, Birnagar, Dutma, Taherpur, Nowanagar etc) just after heavy rain fall when water are moving from the shallower region to deeper beel side. Main Uzaia fishing were from 24-30 April 1993 (average catch was about 1 mt/day and average price was Tk 50 per Kg). Total catch was dominated by GONIA, BOAL, TENGRA, PABDA, SHOAL, PHOLI, AIR, BAIM, GHAGOT, GUTUM and GAJAR. Less abundant species were PUNTI, TAKI, BAILA and RUI.

The abundance of GONIA is higher than for other fishes. More than 70% of the fish were observed with eggs (though most of the large fish are new brood) during this internal migration.

Table E15: Weight of Fish

Species	Maximum Wt (kg)	Minimum Wt (kg)
BOAL	2.25	0.75
AIR	1.80	0.33
GAZAR	1.5	0.50
SHOAL	1.1	0.65
RUI	0.45	0.30
FHOLI	0.24	0.13
KALIBAUSH	0.32	0.17
GULSHA	0.06	0.03
LATI	0.07	0.03
KOI	0.05	0.02
BAIM	0.19	0.08

CHITAL and PABDA occured in the Sonatola beel area.

Special attention was given to fish migration /breeding during April. It was observed that the fish tried to migrate from deeper region (beel side) to shallower region. It was also observed that the Uzaia catch in Tangua haor are several times (not less than 10 times) greater (both in number and weight) than the Shanir haor. Most of the fish in Tangua haor were large and full of eggs swimming from river to haor, and caught on the migratory route. It was reported that four hours catch (on 28 April 1993) by current net were 1750 number of GONIA, where more than 90% were brood fish (500-700 gm/fish).

YEAR 2: May 1993 - May 1994

May 1993: The abundance of fish decreased in comparison with the late part of the last month. The fish were observed to move towards the haor from the river through public cuts and breaches, which helps the easy exploitation of fish by the people. Based on fishermen interviews, fish market observation and NERP sampling findings following categories of fish were observed during this period:

Table E16: Fish Categories (May 1993)

SPECIES with eggs	SPECIES without eggs	JUVENILES
GONIA	KALI BAUSH	MOLA
BOAL	CHANDA	CHANDA
LACHU	CHAPILA	CHELA
CHELA	KEKCHI	KAIKKYA
MOLA	PABDA	DARKINA
BAIM	KAIKKYA	BAILA
GUTUM	PUNTI	PUNTI(s)
TAKI/SHOAL		
TENGRA		
GULSHA		

The haor is inundated during early May, when it was mainly observed that most of the fish were migrating from deeper regions to shallow region with few exception (haor to beel). We try to compare the migration status of Shanir haor area with the Tangua haor (open haor), and it was found that the migration trend to Tangua haor is several times greater than the Shanir haor, which proved the migration barrier caused by the submergible embankment in Shanir haor. The size of the migratory fish is larger in the Tangua haor than the Shanir haor. The fish are more abundant in the shallower region near villages.

June 1993: Compared with the last month, the average size of fish was smaller and fish abundance decreased. Based on fishermen interviews, fish market observation, and NERP sampling findings following categories of fish were observed during this period:

Table E17: Fish Categories (June 1993)

SPECIES with eggs	SPECIES without eggs	JUVENILES
SINGHI	GONIA	MOLA
TANGRA	KALIBAUSJH	CHELA
GULSHA	CHAPILA	CHANDA
	PUNTI	KAIKKYA
	PABDA	DARKINA
	TAKI	BAILA
	BAIM	PUNTI
	GUTUM	GONIA
	BOAL	

Because most of the area of the haor was inundated earlier and the water level increases immediately, it was not possible to identify the migration trend of fish either towards the haor

from outside or towards the river from the haor. It was observed that some cat fish have been caught at night from the shallow region of the haor.

July 1993: Abundance of small fish increased during this month. Some big RUI and KALIBAUSH were caught by the fishermen during this month. One MOHASHOAL (450 gms) was caught by Uther net from Roktimukh. Abundance status of different species are pointed out in the following table. No brood fish of any species was observed except ICHA.

Table E18: Abundance of Fish (July 1993)

High Abundance	Low Abundance	Juveniles
PABDA, KHALISHA, BAIM, GULSHA, ICHA, TENGRA, MPUNTI, CHANDA, POTKA	RANI, BAILA, RUI, KALIBAUSH, SHINGHI, BACHA,GHARUA, GUTUM	CHELA, MOLA, CHAPILA, AIR, EK THOITA

Sudden rise up water level due to heavy rainfall during this month, the migratory pattern can not be recognized. But some RUI (1.5-4.0 kg), KALIBAUSH (0.5-1.5 Kg), BACHA and GHARUA were caught by the Kona jal from the shallower part of the Haor.

August 1993: The overall fish abundance was better than last month. Mainly Carps including RUI and KALIBAUSH were observed. Small fishes were observed more or less same like last month. Degree of abundance of different Species are described in the next table.

Table E19: Abundance of Fish (August 1993)

Increase	No Change	Decrease
GULSHA, LAKIBAUSH, RUI, CHAPILA, PHOLI, CHELA, BADA, BAIM, BOAL, TENGRA, ICHA, KAIKKYA, MOLA	GARUA, SINGHI, BACHA, MAGUR, KHALISHA	GONIA, PABDA, AIR, LACHU

Three MOHASHOAL were caught during this month, one weighed 1,540 gm and had a length of 43.5 cm. It was caught from the Haor area near Islampur village by the Hooks and Line using wheat as bait, while other two were caught (length 35, 35.4 cm and weight 510, 508 gm respectively) by Uthernet from the river near the village Daksminkul.

Four SARPUTI were also caught (length 34, 25.4, 25, 21.2 cms and weight 440, 320, 310,180 gms respectively) from the Dhaksminkul village area.

One DAORA (local name, unidentified fish) was also caught (34 cm, 440 gm).

One large BOAL (about 10 kg) was caught from the haor near Islampur.

Due to maximum flood level some fish are caught which were not found lst year. MOHASHOAL, MRIGEL, SARPUTI were absent during the last two/three years. Some large RUI and KALBAUSH were also caught. These are probably migratory individuals as major fishing occurred during the last year in the Shanir Haor.

September 1993: RUI, KALBAUSH AND CHAPILA catch are remarkably higher than the last year. Maximum RUI is more than 2.5 Kg while only 5/6 RUI of same size were caught during the last monsoon period. Some MRIGAL fry (25-30 cm; 200-275 gm) were also caught from the Haor. No record of MRIGAL catch was found during the last year.

Based on the field observation and NERP sampling following table is developed to show the fish abundance trend during this reporting period:

Table E20: Relative Abundance (September 1993)

Increase	Decrease	Rare
KALIBAUSH, RUI, BAIM, CHAPILA, CHELA, BATA, PUNTI, TENGRA, BOAL, ICHA, CHANDA, SHOAL, TAKI, GAZAR	GONIA, MRIGAL, BACHA, GHARUA, FOLI, SHINGHI, GULSHA, PABDA, LACHU	MOHASHOAL, ILISH, SILVER, CARP, GAGLA, CHITAL, SARPUTI

As water level started declining the young fish starts the overwintering migration towards a deeper region. A number of good catch of big RUI, CHITAL, KALIBAUSH were observed in the Abua River. Some ILISH and SILVER CARP were also caught with RUI and KALIBAUSH during this period.

November-December 1993: As most of the high land has been dried up and beels now possess their own identity. Lessee of different beels restricted common fishing activity throughout the Haor area. But by the illegal catch through out the whole Haor fish abundance can be compared easily with both size and number of different species caught in the last year. Specially large RUI (3-5Kg), KALIBAUSH (100gm-2Kg), CHAPILA, SINGHI, PUTI and BOAL was caught frequently while KOI, MAGUR and RANI are less abundance than the last year. During December RUI, TENGRA, CHAPILA, PUTI, SHINGHI, KALIBAUSH and ICHa were more abundant. CHITAL, BOAL, KECHKI, CHELA, RANI and CHAPILA are more abundance in the River side. Some exotic fish like SILVER CARP, CARPIO and GRASS CARP were also caught during this period.

January 1994: Compared with the last year one can easily guess about more fish abundance in the Haor. Fishermen and people of the Haor area mentioned that fish abundance is two to three times higher than the last year. RUI, GONIA, MRIGAL, GHAGOT, PABDA, SINGHI, GHUTUM, KALIBAUSH, BAZARI, TENGRA, BAILA, FOLI, PUTI, GOZAR and ICHA are more abundant in this month. Specially Large RUI, GHAGOT and KALIBAUSH were more abundant than the last year while LACHU, MOLA, PABDA and KOI seem to be less abundant. CHITAL is the same as it was in the last year. CATAL and MOHASHOAL were observed to be very rare during this year.

Fishing in some shallow beels eg. Tilkhoi fishery, Dhawa beel, Shanirua beel, Atla beel, Chatal beel, Putichora beel was already complete. But the production of the beels are below expectation of fishermen or lessee. They identified some factors for less production:

- Early attaining of harvestable size
- Over fishing pressure on shallow beel
- Delayed Management in relation with growth.

February 1994: On the basis of observations of beel fishing and illegal fishing, fish abundance seems to be three times higher than the last year. Islampur village is acting as the fish arat for illegal catch for the period starting from late December to early March. Out of 40 Nikaries, about 25 are successful in purchasing fish; 20 Kg/day /person of fish on an average. RUI dominated the large fish group and ICHA, TENGRA and BAILA dominated the small group. It was observed that RUI, BOAL, LACHU, GONIA, KALIBAUSH, AIR, GAZAR and PABDA were the main species caught from Kalirduar on 25 February. Local fishermen mentioned that CHITOL, PABDA and RUI are also caught from ahmokhali duar. Some exotic fish eg. SILVER CARP, CARPIO and GRASS CARP have been caught from the Boigani Group Fishery.

March 1994: Fish abundance in Shanir Haor during March are not as much as it was in previous months. The present status of abundance for different species are tabulated in the following table:

Table E21: Fish Abundance (March 1994)

High	Low	Rare
Pabda, Gulsha, Icha, Foli, Gutum, Chirka baim, Taki, Tengra, Taki	Rui, Gonia, Kalibaush, Shinghi, Lachu,Boal	Bacha, Gharua, Chital, Snake Head

April-May 1994: Due to some local rain fall, certain changes were observed in fish abundance which are recorded in the following table:

Table E22: Fish Abundance (April/May 1994)

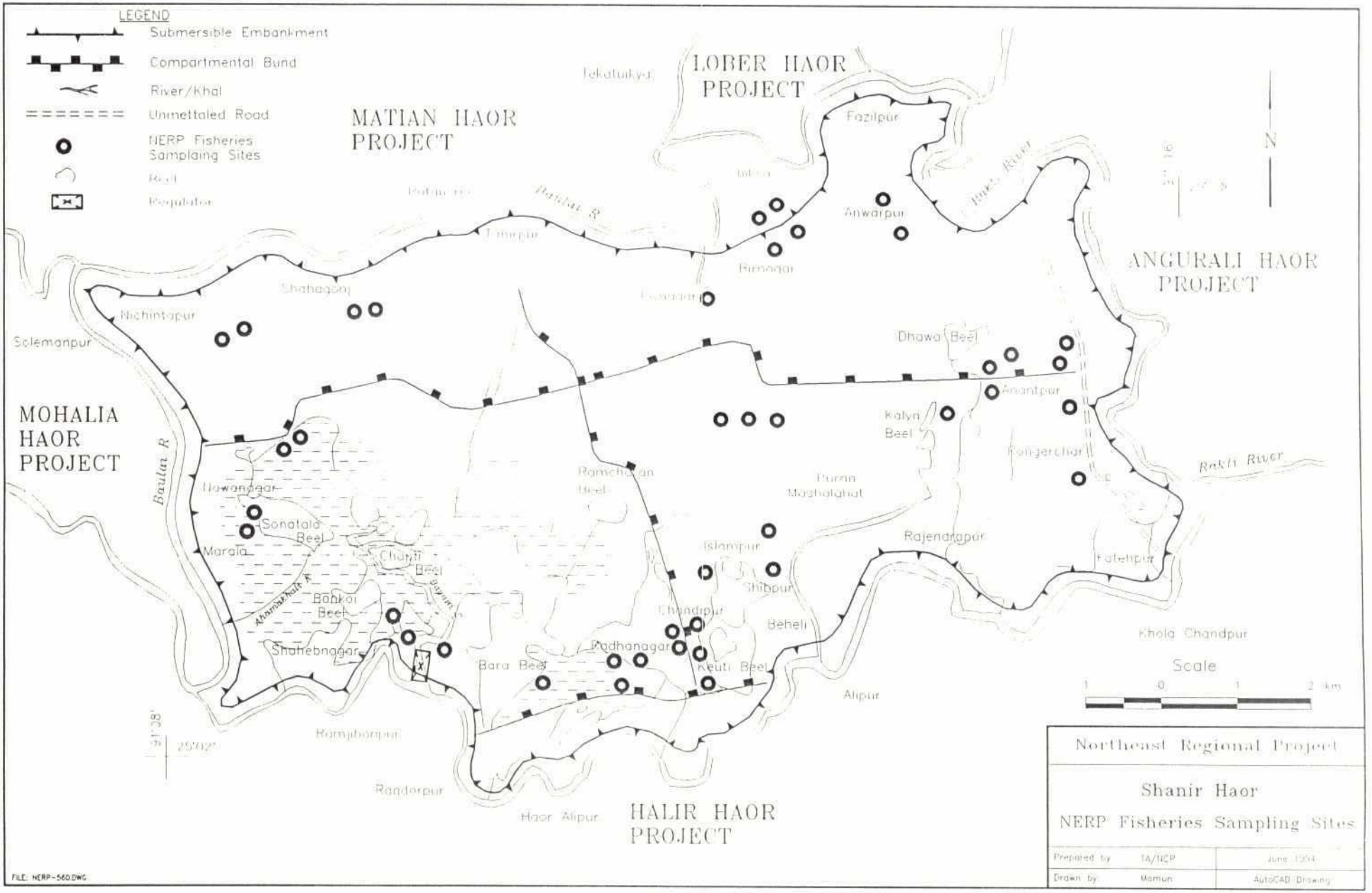
High	Low	Juvenile	Rare
Boal, Gonia, Kalibaush, Gulsha, Icha, Pabda, Lachu,	Tengra, Foli, Rui,Punti, Baim, Gutum	Puti, Gutum, Icha, Chela, Cghanda, Kakkya, Baim	Chital, Carpio, Shoal, Bacha, Gharua

The hydrological changes in 1993-94 improved fish production as flash floods inundated the haor one month earlier than the previous year.

Fish abundance based on NERP sampling

In order to determine variations in fish abundance during the course of the monsoon, sampling was carried out in the following areas (for locations see figure on following page):

- Chandipur
- Islampur
- Radhanagar
- Rongerchar
- Anantapur
- Shibpur
- Shiska
- Anowerpur
- Dutma
- Marala
- Ibrahimpur
- Shahagonj


LEGEND
Submersible Embankment
Compartmental Bund
River/Khal
Unmettaled Road
NERP Fisheries Sampling Sites
Reel
Regulator
MATIAN HAOR PROJECT
LOBER HAOR PROJECT
ANGURALI HAOR PROJECT
MOHALIA HAOR PROJECT
HALIR HAOR PROJECT
Tekatukya
Fazilpur
Anwarpur
Bimagar
Shahagaon
Nichintapur
Soleimanpur
Dhawa Beel
Anantpur
Kalya Beel
Kolgerchar
Rakhi River
Baulai R
Nowanagar
Sonatala Beel
Marata
Chanti Beel
Bonkoi Beel
Shahebnagar
Ramchandan Beel
Purna Meghalghat
Islampur
Shibpur
Chandipur
Rajendrapur
Fatehpur
Beheli
Khola Chandpur
Keuti Beel
Bara Beel
Radhanagar
Alipur
Ramjhorpur
Raidarpur
Haor Alipur
Scale
1 0 1 2 km
Northeast Regional Project
Shanir Haor
NERP Fisheries Sampling Sites
Prepared by: FA/NERP
June 1994
Drawn by: Mamun
AutoCAD Drawing
FILE: NERP-560.DWG

- North of Moshalghat
- Near Sluice gate
- Adjacent to Compartmental band

Specifications of the nets used are as follows:

Table E23: Fish Nets

Gear	Length	Depth	Twine	Type	Mesh
Gill net	17.5m	3.5m	Synth.	Mul. Fil.	5.0cm
Gill net	"	"	"	"	6.3cm
Gill net	"	"	"	"	7.5cm
Gill net	"	"	"	"	8.8cm
Gill net	"	"	"	"	10.0cm
Gill net	"	"	"	"	11.3cm
Gill net	"	"	"	"	12.5cm
Ber jal	35.0m	8.0m	"	"	1.5cm
Kona jal	"	"	"	Mosquito net	2.0mm

The kona and ber jals were each fished by setting them in an arc, and then towing a short distance before lifting. Each net is 50m in length and would encompass a perfect circle with an area of 199 sq m. It is estimated that the area swept by one haul was about 300 sq m (= 0.03 ha). This figure was used to calculate the apparent nominal standing crops from kona and ber jal sampling.

Specifications of the hooks used are as follows:

Table E24: Fish Hooks

Type	TL (mm)	Shank (mm)	Throat (mm)	Gap (mm)
No 5	21.5	16.0	8.0	7.0
No 6	19.0	14.0	7.5	6.5
No 7	16.5	12.5	5.5	5.5

It was observed from NERP sampling that maximum abundance of juvenile fish occurs during the early monsoon.

Standing crops in the two different season clearly indicates the importance of hydrological support to the fishery resources. Late inundation of the Haor/ floodplain in 1992 monsoon causes late breeding and help to maximize the catch of Juvenile/fry during the June when water level increases gradually in the embanked floodplain. Consequently the standing crop declined gradually in the following months up to September. But early inundation of the haor in the 1993

monsoon causes gradual breeding and shows lowest standing crop in May, which gradually increases in the following months and reached in the highest level in September which is more than double that of 1992.

Standing crop estimates by gear for each sampling period are as follows:

Table E25: Standing Crop Estimates - Kona Jal

K O N A J A L				
Year	Month	No of Hauls	Mean Standing Crop (kg/ha)	Range
1992	June	4	70.5	11.0 - 150.0
	July	9	22.1	2.4 - 46.1
	Sept	3	12.7	6.7 - 23.3
	Nov	10	20.4	7.5 - 46.6
1993	May	13	10.9	4.0 - 16.0
	June	8	13.3	5.3 - 27.1
	Sept	8	28.2	3.3 - 58.3

Table E26: Standing Crop Estimates - Ber Jal

B E R J A L				
Year	Month	No of Hauls	Mean Standing Crop (kg/ha)	Range
1992	June	3	13.3	10.8-16.6
	July	11	8.3	2.5-16.8
	Sept	2	10.5	4.3-16.7
	Nov	10	24.9	8.5-70.8
1993	May	9	7.6	2.0-22.0
	June	6	8.2	5.6-12.9
	Sept	4	12.6	5.0-22.8

Though the length frequency of Ber and Kona jal overlapped in same area and time the catch data indicates the maximum Juvenile abundances in the haor during early monsoon.

Table E27: No of Hook Sets - Longline

LONGLINE			
Year	Month	Total No of Hook Sets	Mean CPUE (kg/100 hooks)
1992	July	300	0.23
	Sept	292	0.26
	Nov	300	0.33
1993	May	100	0.61

The gillnet sets caught very few fish:

Table E28: No. of Sets - Gillnet Gang

GILLNET GANG			
Year	Month	No of Sets	Catch
1992	July	2	One kalibaush (700 gm)
	Sept	3	Three juvenile kalibaush 22.5 cm, 140 gm (5 cm mesh) 21.0 cm, 120 gm (5 cm mesh) third not measured
	Sept	1	One fish ? (1.23 kg)

January 1993: Due to no water in the flood plain and strong restriction over fishing in the beel area we have no scope for sampling in Shanir haor. We try to maintain a close contact with lessee as well as fishermen to obtain reliable data about their catch.

February-April 1993: No NERP sampling was taken place during this period.

July 1993: No NERP sampling has taken place during the reporting time.

August 1993: No NERP sampling was performed due to rough weather during this month.

November-December 1993: No NERP sampling was performed due to rough weather during this month.

January 1994: No NERP sampling has been taken place during this period.

February 1994: No NERP sampling has been taken place during the reporting time.

YEAR 1: May 1992 - April 1993

October-November 1992: Fish disease was observed in the eastern part of the haor during mid October. It was reported that a few diseased fish were also found during mid September. The intensity of the disease is higher in the shallower region than the deeper western region of the haor. Comparing with the hydrological data of the Shanir haor it was observed that there is a close relation between the amount of drop in water level and intensity of disease. During late October to early November we observed that some fishes of different species (BHEDA, BAIM, PUNTI and LATI) have been attacked by the Ulcerative Syndrome disease. The intensity of the disease increases gradually with the gradual dropping of temperature and water level. It was reported by the people that due to severe contamination of the disease since 4/5 years, most of the mentioned species had almost vanished, although the abundance of some of these species appears to be higher this year.

January 1993: During late January we observed that the incidence of fish disease reduced remarkably. No diseased fish was found in Tilkhoi fishery during beel harvest on 22 January 1993. It was identified that about 50% of BHEDA, BAIM, PUNTI, LATI, GAGER etc. were found to be contaminated during late December 1992. It was reported by the local fishermen (including Fishermen living in the Khola) that the intensity of disease reduced after flash flood on 8-9 January. It is the opinion of the local fishermen that the flash flood waters act as "a medicine of the disease". We discussed with the fishermen (22/01/93) in the khola (who are watching the fisheries status in the haor to start beel fishing) who informed that about 50 - 60 % of fish (BHEDA, BAIM, PUNTI, LATI, GAGER etc.) were contaminated by the disease but after the late flash floods during 8 - 9 January fish disease is reducing. It should be mentioned here that during our observation in the Tilkhoi we did not find any diseased fish in their catch while in the Patasingra beel of Monu project area even diseased CATAL and BOAL (Catal and Boal contamination is very rare) were caught (on 19/01/93).

February-April 1993: No single witness of disease was observed during this period.

YEAR 2: May 1993 - May 1994

May 1993: No single evidence of disease was observed during this period.

June 1993: About five infected fish were observed during NERP sampling. The observed species were PUNTI, TAKI, BAIM and KAIKKYA. It was not possible to determine whether the fishes were diseased or wounded by other means.

July 1993: No report was received during this period on fish disease.

August 1993: No diseased fish was observed or no such report was received from any source during this period.

September - October 1993: No diseased fish was observed or none reported about fish disease during this period. Some diseased fish were observed during the month of October. These were Tangra, Taki, Baim, Puti, Batha.

November-December 1993: A very few diseased fish were observed during this period. BAIM, TENGRA, TAKI, PUTI and BHEDA are mainly the disease-effected species observed during the period.

January 1994: Fish disease was in controlled stage during this year. Less number of diseased fish were observed than the last month. BAIM and TAKI/LATI were also observed to be effected but the situation is improving rapidly than the last year.

February 1994: Although diseased fish were found during the last few months, only a very few diseased fish were observed during this reporting period.

E.4 MONITORING OF FISHERIES

Fishing communities

There are 47 villages located in the Shanir haor, most of which are on the boundary of the haor except southeast part. About 30,000 people are living with in the haor among which about 4,000 (13 %) lived on fishing. During monsoon, most poor people go for fishing due to unemployment problem. Some poor people (including fishermen) having no earning scope to survive left the haor area. The fishing community of the haor fluctuated with the fish abundance as well as fishing scope. It was observed that the people residing near the water body more or less go for fishing either for their family consumption or for marketing. The total fishing communities of Shanir haor can be classified on the following ways :

Genuine Fishermen: The people who are born to fishing families and believe it is their right to fish. They are also called as traditional fishermen.

Regular Fishermen: The people who live on fishing and fisheries activity. Fishing and fishery activity are their main profession.

Seasonal Fishermen: The people who live on fishing for a particular season of the year. In general they are less skilled poor people who fish in a particular season (normally during monsoon) of the year.

Occasional Fishermen: The people who go for fishing occasionally. They go for fishing normally depending on fish abundance, fishing scope and unemployment problems.

A representative of the fishery leaseholder states that fish production increased substantially due to the project, which helps maintain the depth of water required by the pile fishery. They indicate that the GOB Fishery and Pearl Development Program is responsible for leasing the *jalmohal*. Reportedly the *beel* contains many different fish species. Local people state that the leaseholder does not allow them to fish in the *beel*. They request changes to the leasing system to permit them to fish.

Some traditional fishermen have changed their profession due to a decline in fish production.

Particular features of the fishing communities within Shanir Haor are as follows:

- Regular and seasonal fishermen dominate throughout the monsoon.

- The genuine fishermen are involved in fishing throughout the year but they have less control on fishing inside the haor, because most of the fishermen villages are located on the embankment of the river.
- Due to no other employment scope than fishing inside the haor area, people residing near the beel go for occasional fishing in the haor particularly during mid-monsoon.
- Total fishing intensity increases through the monsoon season.
- Restriction created by the lessee during late monsoon stop all sorts of fishing activity causing unemployment problems to the whole fishing community.

Involvement of the fishing community and their influence on fishing are shown below:

Table E29: Fishing Communities

Fishing Group	No of Villages	Name of Villages	Fishermen	
			No of Groups	No of Fishermen
Genuine	12	Beheli,Fatehpur, Barokuri, North Barunka, Gopalpur, B.Alipur, U.Taherpur, Sahebgonj, Daksminkul, Barkhola, Rajdharpur, H.Alipur.	164	334
Regular	11	Shibpur, Chandipur, Radha nagar, Rajendrapur, Nowana gar, Nischintapur, Shahago nj, Sripur, Ratansri, Tahe rpur, Shahagonj	237	352
Others	22	All villages within and around the haor		

Some of the fishermen of Beheli, Alipur, Haor Alipur, Shahebnagar, Kamdebpur, Anowerpur, Taherpur and Latippur changed their profession due to entry of non traditional fisherman backed by influential rich person into the fishing. Some of them (eg. Daksmin kul) do not fish in Shanir Haor but in the surrounding rivers.

Though the villagers of Islampur, Chandipur, Radhanagar, Bhati Taherpur and Nawanagar are not traditional fisherman, it was blamed that they are dominating the fishing activity throughout the Shanir Haor area. About 80-85% of the people of these villages have become regular fisherman.

The villagers of Sapnagar, Ramjibanpur, Harinakundu and Rajdharpur are seasonal fisherman who fish for income only in the monsoon season due to a lack of other employment opportunities.

A detailed distribution of fishing households are shown overleaf.

SHANIR HAOR - PMP - SOCIAL ANTHROPOLOGY

(July 1992)

DISTRIBUTION OF FISHING HOUSEHOLDS

No.	Village	Thana	Households	Hindu	Muslim	Traditional Fishermen Households	Non-Traditional Fishermen Households	Households Living From Fishing in July 1993
1	Borokuri	Bishamborpur	38	23	15	23	13	36
2	Khidirpur	"	110	-	110	-	20	20
3	Shahpur	"	207	-	207	-	25	25
4	Noagaon	"	52	52	-	-	1	1
5	Fatehpur	"	102	102	-	30 (Mahitsho Das)	-	-
6	Noabarunka	"	160	160	-	29		28
7	Timarjalal	"	62	-	62	-	4	62
8	Pathari	"	21	-	21	-	-	-
9	Rajendrapur	"	200	-	200	-	6	6
10	Dhawa	"	135	-	135	-	15	15
11	Bagua	"	160	-	160	-	9	9
12	Bashontopur	"	251	-	251	-	25	25
13	Lakha	"	36	35	1	-	7	7
14	Rongarchor	"	24	24	-	-	-	-
15	Alipur	"	54	-	54	-	4	4
16	Sripathangar	"	10	-	10	-	-	-

No.	Village	Thana	Households	Hindu	Muslim	Traditional Fishermen Households	Non-Traditional Fishermen Households	Households Living From Fishing in July 1993
17	Mahmudpur	"	42	31	11	8	4	5
18	Puran Barunka	"	140	25	115	-	8	8
19	Gupenather Noagaon	Tahirpur	70	70	-	-	2	2
20	Marala	"	65	-	65	-	20	20
21	Shahebnagar	"	33	12	21	12 (Bormon)	5	9
22	Ekrampur	"	31	31	-	-	-	-
23	Nichinpur	"	29	-	29	-	8	8
24	Anwarpur	"	210	20	190	-	30	30
25	Lohachar	"	110	30	80	7	-	-
26	Noarhat	"	21	21	-	-	-	-
27	Fazilpur	"	15	15	-	-	-	-
28	Dhutma	"	76	20	56	-	8	8
29	Birnagar	"	140	-	140	-	3	-
30	Joynagar	"	65	-	65	-	5	5
31	Gopalpur	"	14	-	14	-	4	4
32	Sripur	"	180	-	180	-	10	30
33	Sublargao	"	120	-	120	-	5	5
34	Noyanagor	"	69	-	69	-	24	24
35	Ushonpur	"	85	-	85	-	2	-

No.	Village	Thana	Households	Hindu	Muslim	Traditional Fishermen Households	Non-Traditional Fishermen Households	Households Living From Fishing in July 1993
36	Chikma	"	360	100	260	-	-	-
37	Shahgang	"	56	20	36	-	3	3
38	Islampur	Jamalgonj	164	-	164	-	78	78
39	Beheli	"	155	155	-	16	-	3
40	Puran Moshalghat	"	175	-	175	-	6	6
41	Radhanagar	"	193	-	193	-	16	16
42	Chandipur	"	54	30	24	2	0	2
43	Moshalghat	"	46	46	-	-	-	-
44	Prokashnagar	"	26	-	-	26 (Maimol)	-	20
45	Tilkoi	"	22	22		8 (Mahitsho Das)	-	3
Total-			4388	1044	3344	161	370	543

Table E30: Fishing in Open Water Bodies, July-August 1993

Village	Households involved in fishing	Gear used	Daily income (Tk)	Remarks
Radhanagar	30			15% of households are dependent on fishing
Sahebnagar	10	Larborshi	250	3 boats are used for larborshi. In each boat, two persons are involved in fishing. After selling their catch, they would get Tk 200-250 daily per boat. After the flood of 11 June 1993 they could earn at best Tk 100 tk daily per boat.
Gopalpur	9			50% households are dependent on fishing.
Shibpur	20	Konajal and Current jal		20 households are dependent on fishing. 18 households use konajal and 2 households use current jal.
Chandipur	2	Current jal		Fish are not available due to flood dated 11 June 1993.
Islampur	30	Larborshi		30 households can meet their subsistence need by fishing with this type of gears.
Barkuri	22			All are traditional fishermen.
Fatepur	12	Larborshi and daita	50-100	All are traditional fishermen. 4 households are involved in fishing with larborshi and 8 are involved in fishing with daita. Daily incone from larborshi is Tk 100 and from daita is Tk 50.
Alipur	10			10 households are dependant on fishing.

Source: Field observation

Table E31: Fishing in Open Water Bodies, September 1993

Name of gear	Fish species
Utharjal:	Kalibaush, Rui, Mrigel, Boal, Chitol
Larborshi: (according to tup used)	Tup by icha: Baim, Kangla, Pabda, Shing, Magur, Shol
	Tup by wheat: Kailla, Rui, Pabda, Gojar
	Tup by worm: Lati (Taki), Shol, Gojar, Tengra, Shing, Magur
	Tup by chikra baim: Boal, Gojar, Shol, Chitol
Daitta	Tp by icha, foring, worm: Lati, gulsha, Shing, Magur, Shol, Pabda, Koi
Chai (gui)	Tup by snail: Tengra, Gulsha
Thelajal	Icha, Chanda, Chela, Titputi
Daratana	Chikra baim, Chanda, Titputi, Icha, Tengra

Source: Field observation

Non-traditional fishermen from different villages of Shanir Haor are engaged in fishing in this time using different gears, such as, larborshi, putpain (sutarjali), konajal, current jal, daitta, chai, daratana, etc. It may be mentioned that the use of both konajal and current jal are strictly prohibited in fishing.

From the month of September (1993), it is seen that some are fishing with prohibited gears. In Shanir Haor, some non-traditional fishermen of almost every village are involved in fishing with larborshi. Among the villages of Shanir Haor, Islampur has the highest number of larborshi with boat. There are 50 larborshi boats in Islampur. The guards appointed by the lessee punish them if they can catch hold of the "unauthorised persons" fishing in the lease area and their gears are taken away by the guards. As a result, the income of non-traditional fishermen has declined. They could earn about Tk 70-80 per day from fishing if they would have been allowed to continue it.

There are 15 utharjals which are used in fishing in the rivers of Nainda and Abbuya during September. The traditional fishermen of both the villages of Kholachanpur and Bardal are fishing there. They are not giving any rent to the lessee. But they are afraid of the local administration.

The Puitta river was been taken on lease in accordance with the provisions of Nitimala by the traditional fishermen of four villages: Beheli, Alipur, Gopalpur and Barkuri. The rent is Taka 41,490. This river was subsequently sub-leased to another person of the Shahebnagar village on condition that 60% of profits would accrue to the sub-lessee and 40% to the primary lessee.

Table E32: Fishing Households (October 1993)

Village	Total HH	No.of traditional fishermen	No.of non-traditional fishermen	Subsistance fishermen	HH who buy fish
Fatepur	105	33	-	52	20
Anwarpur	210	23	50	70	67
Birnagar	140	-	40	50	50
Shahganj	64	-	32	25	7
Maral	67	-	15	40	12
Nayanagar	69	-	35	31	3
Islampur	164	-	160	4	-
Total	819	56	332	272	159

Source: Field observation

In Shanir Haor, Nimbaich (fishing collectively on a fixed date) took place in the Beheli nadi on 21 December. The fishermen of three villages, Beheli, Kholachandur and Barkuri, participated in this nimbaich with their fishing gears. The fishing gears used were:

4 ottarjal from Beheli
11 ottarjal from Kholachandpur
3 ottarjal from Barkuri
---
18 ottarjal

5 bacharjal, 3 jhapjal of Kholachandpur
2 bacharjal, 1 jhapjal of Barkuri
---
7 bacharjal, 4 jhapjal

Total number of fishing gears is 29 which are used in this nimbaich. Under this baich, mostly kalibaush, chital, air, boal, pabda, tengra, gulsha and bara chingri were caught. The fish were sold to local nikaries through auction. The total sale of fish under this nimbaich was 19,000 taka. The fishermen received a share of 37% and earned 7124 taka. The lessee got 63% share from sale proceeds. Nimbaich took place only in the Beheli nadi and other two rivers where specific places were surrounded with branches of trees, bamboo, water hyacinth, etc. After fishing those specific places, the catch was transported to Sylhet aarat by mechanised boat and truck.

Abbuya nadi: On 22 December 1993 nimbaich started in the Abbuya nadi and then continued on 23, 27, 30 and 31 December. The fishermen of different villages, such as, Kholachanpur, Barkuri, Beheli, Khirdharpur, Barkhola and Dakshinkul, are involved in fishing in this nimbaich. Different fishing gears, such as, 22 jhapjal, 12 otterjal and 5 bacharijal were used. The fishermen who were fishing during the above-mentioned five days, received 25% share of total sale proceeds and the rest accrued to the lessee. Total sales amounted to 97,000 taka up to 31 December 1993. Fish were sold to the local nikaries by auction. The nikaries sold the fish to the aarats in Sunamganj and Sylhet.

Frame survey of fishing effort

To estimate the catch of Shanir haor frame survey on fisherman and gear was started during mid-July. The fishermen of this area formed unit/group having 1-12 numbers of fishermen (usually 1-3) depending on traps/ gears. Each group possess at least one country boat including traps and gears. Depending on season/ water level/ species abundance/ fish size/ fishing area they select their gear and form their group. Chai/Gui, Gillnet and Hooks & line are very common to all units.

Different types of fishing gear used in the area and sometimes choosing of gear depends on types of fish expected in the water body. Ofcourse, some gears are susceptible to some specific species. Again, some gears are applicable only in some region which depends on depth of water. Following are the commonly used gears:

Uthar jal: Mainly operated in the river and other deeper parts of the floodplain. The conical shaped net, which is 100 feet long and circumference is about 500 feet. The gear is used for the following species : Air, Ghagot, Chital, Boal, Rui, Kalibaus etc.

Kona jal: Mainly operated on the floodplain, beel and sometimes in the shallower parts of the river. The rectangle shaped net which is 400-500 feet long and width is about 30-45 feet. The gear is used for the following species: Batashi(Aluni), Chapila, Pabda, Bojori, Mola, Kechki, Puti, Foli, Kaikka, Chanda, Tengra, Chela, Napit, Icha, Cirka.

Khora jal: Mainly operated in the river. The gear is used for the following species : Chapila, Kechki and other smaller varieties.

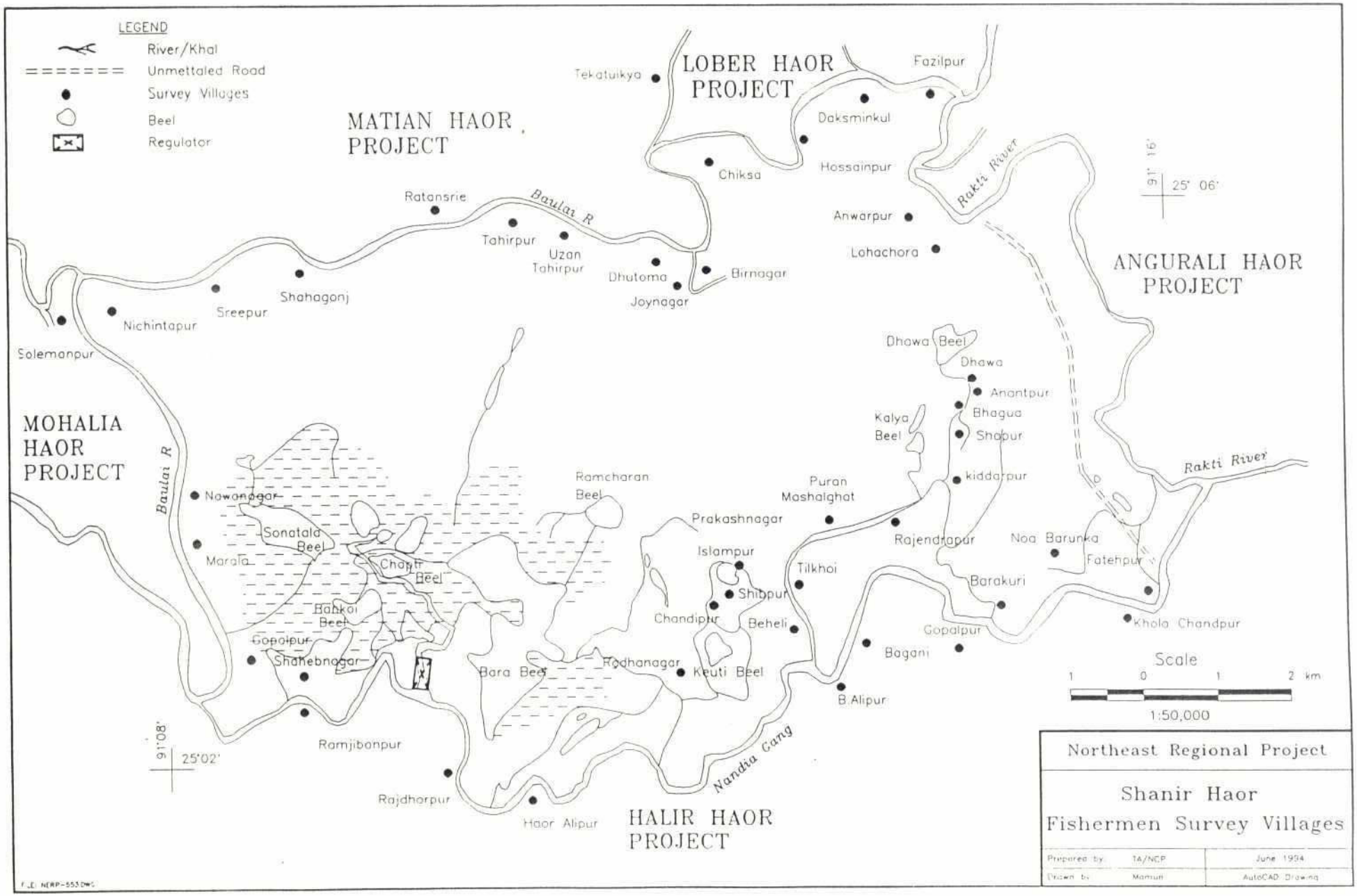
Horhoria jal: Mainly operated in the river and floodplain. The gear is used for Tengra, Golda, Ghagot, Air.

Thela jal: Mainly operated on the floodplain. The gear is used for icha, cirka and other smaller varieties.

A peculiar character was observed within and around the Shanir haor during our frame survey. A continuous change in numbers of fishermen (i,e,some are entering in the fishing profession while some others are leaving) may possibly threaten the fisheries resource in the near future. Some fishermen residing over the haor avoid fishing in the Shanir haor while some fishermen living out side of the haor are interested to fish in the haor. In the NERP frame survey all the fishermen who are interested to fish in Shanir haor were included.

Fishing communities visited for the frame survey during the 1992 monsoon are tabulated below (these figures changed during the 1993 monsoon due to higher fish abundance):

The location of the fishermen survey villages are shown in the figure overleaf.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Chiksa
Ratansrie
Baulai R
Tahirpur
Uzan Tahirpur
Dhutoma
Birnagar
Joynagar
Anwarpur
Lohachora
Rakti River
91° 15'
25° 06'
Shahagonj
Sreepur
Nichintapur
Solemanpur
Dhawa Beel
Dhawa
Anantpur
Bhagua
Shapur
Kalya Beel
kiddarpur
Puran Moshalghat
Rajendrapur
Noa Barunka
Fatehpur
Khola Chandpur
Barakuri
Gopalpur
Bagani
B.Alipur
Tilkhoi
Prakashnagar
Islampur
Shibpur
Chandipur
Beheli
Ramcharan Beel
Nawanagar
Sonatala Beel
Marala
Chaiti Beel
Bankoi Beel
Gopalpur
Shahebnagar
Bara Beel
Radhanagar
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Ramjibanpur
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1:50,000
Northeast Regional Project
Shanir Haor
Fishermen Survey Villages
Prepared by: TA/NCP
June 1994
Drawn by: Mamun
AutoCAD Drawing

Table E33: Fishing Gear Units

Village	No of FSM GRP	No of FSM	No of Gear Units							
			UJ	KJ	LL	CF	DT	T	DC	OT
Beheli	4	14	4	1						1a
Shibpur/ Chandipur	13	47		7	3	2		4		
Radhanagar	8	19		2	6	6				
Rajendapur	6	14		2		4				
Moshalghat	4	4	19		2	5				
K Chandpur	27	54								8b
Fatehpur	9	9	5				9			
Barokuri	15	24			5					6b2c 2d
N Barunka	17	26	4	1	1		15	2		
Gopalpur	50	75		3	48				14	5c
B Alipur	28	35			25	3				
U Taherpur	8	39		7	1					
Anowerpur	10	10					10			
Hossainpur	3	4				3				
Lohachhara	3	3					3			2e
Chiksha	12	12				5	5			1c1f
Sahebnagar	5	17		2	1					
Marala	3	14		2		6				
Nawanagar	16	28			8	14		1		1g
Solemanpur	7	30			7	7				
Nisch. pur	8	10				8				
Shahagaon	3	5				3				
Sripur	5	10		1		4				
Ratansri	7	17		1	1	5				
Taherpur	21	52		8	4	9				
Dutma/ Joynagar	2	4				2				
Bir nagar	3	5				2		1		
Tekatuikya	5	9			5					
Daksminkul	4	19	4	3						

Table E33: Fishing Gear Units (Cont'd)

Village	No of FSM GRP	No of FSM	No of Gear Units							
			UJ	KJ	LL	CF	DT	T	DC	OT
Barkhola	7	15	3	4						
Rajdharpur	7	22			7	7				
H. Alipur	10	39		1	6	6				
Anantapur	7	7			1	5				
Bhagua	15	11		1		7				
Shahapur	150	150			15	150				
Khidderpur	15	15			10	5				
Bagani	30	25			9	6				
TOTAL =	547	893	39	46	165	274	42	8	14	**

** 1a; 14b; 6c; 2d; 1f; 1g

Notes:

UJ	Uther net (2-4 persons makes a unit)
KJ	Kona Jal (8-20 persons makes a unit)
LL	Hooks and long line (2 persons make a unit
CF	Current/Footpain (2 persons make a unit)
DT	Daittya (1 makes a unit)
T	Traps (2-3 makes a unit)
DC	Dol/Chouhanda net (for Katha fishing)
OT	Others (a, b, c, d, e, f, g)

a	=	Jhaki jal (1 makes a unit)
b	=	Khora jal (1 makes a unit)
c	=	Boro jal
d	=	Jhap jal (more than one makes a unit)
e	=	hand hook (1 makes a unit)
f	=	Phera jal(2-3 makes a unit)
g	=	Koach (1 person makes a unit)

The number of nets or traps fished by an individual fisherman or a group varies as follows:

Table E34: Nets and Traps

Gear	Specification	Number per Unit	Range
Kona Jal	150-300m x 6-8m	1	1
Current / Footpain	100m X 1.2m (= 0.5kg of netting)	8 pieces (= 4kg)	1-12 pieces (= 0.5-6kg)
Hooks and Longline	Hooks, longline	1,250	400-1,500
Chai	Bamboo Traps	50	35-70
Daittya	Hooks, Stick	40	35-50
Gui	Bamboo Traps	25	20-30

A net called PHERA JAL is used by some fishermen in the rivers around Shanir Haor. This net is used as a drag net to harvest bottom feeding fish (mainly TENGRA). The PHERA JAL consists of a bag net and a long rope. One third of the mouth of the net is attached to the middle of the rope and rest of the mouth is equipped with float to make a wide opening during operation. The rope is very thick and act as a weight to keep the net on the bottom.

Seasonal changes in fishing gear use

Depending on species, fish size, fish abundance and location, fishermen use appropriate gear. Line Fishing is the main fishing method during the whole monsoon. Different types of bait are used to catch different types of fish. Usually small Itcha, Grass hopper, Earthworm, semi-boiled Wheat, live Baim, Snail muscle are the common bait used in Shanir haor. Kona Jal is also the common net during the whole monsoon. Normally it is used in the shallower region to catch the juvenile and smaller species causing a severe decline in fish stock. This is an illegal gear though it is used every where randomly. The approximate degree of use of various gears during the monsoon flood period in 1992 was as follows:

Table E35: Use of Gear (June - November 1992)

Gear	Month					Area
	JUNE	JULY	AUG	SEPT	OC/ NV	
Hooks & Line	Moderate	Moderate	Major	Major	Minor	Throughout the haor
Kona Jal	Moderate	Moderate	Major	Moderate	Minor	Shallower region
Gillnet Foot-pain	Minor	Minor	Major	Heavy	Moderate	Throughout the haor
Traps	Moderate	Moderate	Moderate	Minor	Minor	Bushy higher land
Daittya				Minor	Major	Bushy shallow area

Over all observation on gear throughout the monitoring period are described below.

YEAR 1: May 1992 - April 1993

June, 1992: Line Fishing (Hook) is the main fishing method throughout the haor area. Lati (bait - chingri), Baim (bait - chingri), Pabda (bait - grass hopper), Tengra and Singhi (biit - chingri) was the main species caught. Bamboo Traps (CHAI) are used at the breaches in the embankment to catch Tengra in the eastern part of the Haor. Kona Jal is used by the Fisherman to catch fish fry in the Haor. This type of net was banned by the Govt. The low abundance of large fish is partly to blame for the use of Kona Jal. Gill nets are used in the eastern part of Shanir to catch Gonia, Singhi, Lati etc., but the catch was negligible.

July, 1992: Line fishing is the effective fishing method during this period. Earthworm, Grass hopper and Chingri(icha) are the main baits. Both day and night fishing is going on, though there are better catches at night. Fishing by Bamboo trap is increasing due to a greater abundance of Tengra. There are two types of Bamboo traps used in Shanir haor. Chai is a rectangular trap made in Comilla, costing Tk 30. Gui is a cylindrical trap, locally made, costing

Tk 18 per trap. Bamboo traps were used in bushy submergible embankments throughout the haor during the night. Tengra is the main species of the bamboo traps. Gill Nets (including current net) are rarely used at present. Some nets are used in the bushy north east area of the haor. Kona jal (made by mosquito net) is used by the fishermen in the shallow stagnant water near villages.

August, 1992: Line Fishing is the main fishing method during this month. Due to relatively good abundance of large fish during this month, fishermen are using semi boiled wheat, live small BAIM, snail muscle etc. in Hooks as bait. Number of Hooks, Distance between two Hooks, Length of line varies fisherman to fisherman depending on fishing location, targeted species and kinds of baits. Fishing by Footpain (Gillnet) is increasing following the falling of water levels of the haor. It is assumed that from mid September most of the fisherman will use Gill net to maximise their harvest. A huge number of KONA JAL were used during this month. It was reported that 3/4 new groups with Kona nets were engaged in fishing during August. Every month the number of KONA jal is increasing due to a decrease in abundance of fish (mainly large fish). This type of net operation started 5-6 years ago and is now the favourite gear. Fishing by Bamboo traps is continuing similar to the last month. We observed another method of fishing called "DAITTYA fishing" in the eastern part of the Haor, which is another form of Hooks and line fishing. In this process fishermen use a floating stick to tie a single hook in the place of long line. In the western part, we observed some non fisherman are fishing by DARATANA. Normally this type of gear is a favourite one for non fisherman poor people who only harvest small fishes (chingri etc.) from the shallower region for their family consumption. But due to less fish abundance, this gear is used by some fishermen to harvest the small sized BAIM to use as bait for Long line fishing. Fishermen of Khola Chandpur normally use UTHER net throughout the year and other group of fishermen of eastern part of the haor uses different types of nets which are mentioned under the Frame Survey.

September 1992: The use of fishing gear generally remains unchanged since last month. One exception is increased use of FOOTPAIN (gill net), because, due to the declining water level, fish are more active in their movements (ie migrating from shallow to deeper parts of the haor) which renders them more vulnerable to capture with gill nets. BOROMAACH apparently navigate along the submerged khals and canals (in response to their physical structure [ie depth] and microcurrents flowing along them), and fishermen set their nets there. The PAHARADARS of the leaseholders are generally trying to prevent fishermen from using any and all types of fishing gear all over the haor. This forces fishermen to restrict their operations to the fishing grounds close to their home villages. Furthermore, if they fish in groups they are more likely to be able to resist such pressure effectively. However, this fishing pattern results in intensive exploitation (and overexploitation) of the fish resources near the villages, something which would not happen if fishing effort was more randomly distributed over the whole haor.

October-November 1992: Daittya is the main fishing gear during this period, which reduces the risk of loss by the fishermen to the guards (one hook tied up with a floating stick by 0.5m twine). Current net and long line fishing are also becoming more important though their use is risky. KONA JAL operation is very rare in the haor (only around Islampur and Beheli). Some fishermen are using PHERA NET to catch the Mystus spp. (AIR, GULSHA etc.) cat fishes from the river. THELA JAL were used by the children and youth for their family consumption. DARATANA fishing is also an interesting fishing method of local people getting some fish for their daily consumption. The lessee and fishermen installed some KHATA both in the haor and river.

January 1993: Chouhanda, Kona, Ural and Rek(caste) are the main gears used for Khata fishing.

February-April 1993: Current net and harpoon (PIER) are the main gears used to catch fish. Because of spawning migration towards shallow region it is easy to harvest big broodfish by harpoon. In most cases current nets are sited in the migratory routes. Chai and Hook fishing (one big hook with one stick) are also the present fishing system both in haor and river side.

YEAR 2: May 1993 - May 1994

May 1993: Kona jal is the main gear by which a huge number of juvenile fish are caught, causing a serious loss in fish production. Hooks and line and Current nets are also used by the fishermen. On kanda or shallower region bamboo traps are used to catch Gulsha/Tengra fish.

June 1993: Kona jal, Current jal and Hooks & Line are the main gears during this period. Some traps are also used by the fishermen.

July 1993: Kona jal, Current net, Hooks and Line, Gui, Daratana and some Daittya were used by the fishermen during this month. Uther was also observed in the riverside.

August 1993: Kona jal, Current net, Gui, Daitta and Daratana are the main gears used in the shallow part adjacent of the villages of the Haor. In the deeper area of the Haor some Hooks and line were observed to be used while Uther and Khora nets were used in the River side.

September 1993: Kona jal, Uthernet, Hooks and Lines, Current net, Daittya, Gui, Dartana, Thelajal and Koch are the main fishing gears used during this reporting period.

November-December 1993: Current net, Thelajal, Jhaki jal and Konajal were the main gears in the Haor area and Uther net, Hand line, Bheshal net were used in the River side during this period.

January 1994: CHOUHANDA, UTHER, JHAP, and KONAJAL were the main gears used in beel fishing. For Nim fishing in the river Uther, Jhap and Kona jal are used, different types of Hooks and Line are also used in the river. Illegal fishing was performed using Chai and current net. In shallow areas children are using Thelajal to catch small fish like ICHA, CHANDA, PUTI etc.

February 1994: Chouhanda, Kona, Jhapjal, Uther, Dolnet, Current net, and Gill net are the main gear used in beel fishing. Chai and Thela jal are used by the poor fishermen in the shallow area of Islampur, Chandipur, Shibpur and Radhanagar.

Annual beel fishing

Following are the major beels where annual beel fishing is going on during the winter.

- Boigani group Fishery
- Putichora group Fishery
- Shanirua beel
- Dhawa beel
- Chatal group Fishery
- Tilkhoi Fishery

The Boigani Group Fishery is the main fishery within the Shanir haor. It includes Bara beel, Sonatola Beel etc. The lessee (13 years lease period) of this fishery controls the total fishing activity over Shanir haor. This group fishery was one of the most productive in the area when pile fishing was the main fishing system. There was a good potential for mussel culture, and the govt. leased it out to the lessee for fish and pearl culture. But the lessee was restricted in his operations due to litigation with the previous lessee.

Winter of 1992-93

The sluice gate operator, manager of the Bogiyani Khola, farmers and fishermen offered the following information:

- Important fishery in the haor are: Sonatala, Kosma, Kalirkhau, Modarkona, Berrighoop, Ramchanna, Kalirdoar. These all are perennial water bodies.
- Every year fish production is declining (90% decline compared with the production of 7 years before).
- Important fish species are: Gonia, Boal, Kalibaus, Chapila, lacha and Rui. Present year Rui is very scarce.
- Among the total catch 85-90% are small fish and 10-15% are large fish.
- In the river, few fish are available.
- There is some water blocked inside the haor. People in the area mentioned that the sluice gate required some structural changes, and that installation of more regulators is required.
- Fishermen and the local people believe that the decrease of fish are not the result of the submersible embankment. They said, the reason of low catch are the results of (1) complete dewatering during harvest, (2) use of fine meshed net and current jal in the breeding season and (3) siltation.

Now the lessee harvests fish annually and hires fishermen from the outside. During our sampling on 8 Nov 1992 we met with a group of Koibortya near the regulator who arrived there from Sallah 1/2 hour before. The discussion points are noted below:

- Babu Madhu Das of Lakhai made a contract with the lessee for annual fishing. Mr. Das who has another two contracts at Baulai Beel near Mukshedpur and Alma Kalma Beel near Taherpur for fishing. He is also the lessee of Atnijahur Beel near Sallah and Dhailong haor near Itna.
- There are 10 members in this group who will continue for 1 month to do specific harvesting works:
  - Closing (by nets and bamboos, only to protect fish) of 4 points (regulator canal, near Puntimara, near Shahagonj, near Ramjibanpur).
  - Covering of Katha with water hyacinth mats.
  - Construction of the Khola.
- After one month, another 30 - 40 fishermen will join with this Koibortya group. 60 - 70 no. of Chat fishermen will also join to help them.
- The main fishing period will be in February and March.

January 1993:

BOIGANI GROUP FISHERY

The hired fishermen of boigani group fishery completed their khola. The khola seems to be an active village from December. The khola is subdivided into distinct areas for the fishermen community and for management (lessee's representative, paharader). The fishermen community area includes all types of fishermen who reside in the khola though they are sub divided into different groups depending on their permanent address as well as their gear used. Present fishermen status of khola are given below:

Table E36: Hiring of Fishermen

No and Name of Group	Gear	Fishermen Hired from
24 Chat (4 persons/Chat)	Chouhanda	Lakhai, Nasimnagar
1 Dol (40 person)	Dol net	Lakhai, Nasimnagar Austragram, Kalma kanda.
3 Khorajal (1 or 2 persons)	Khora Jal	Shachna(Jamalgonj)
1 Berjal (12 persons)	Ber Jal	Kalipur(Jamalgonj)
6 Pati Jal	Pati jal	Ajmiriganj

The fishermen group is led by a non fisherman named Babu Sudangsu Chakraborti from Dherai who is working in this field since 11-12 years. He informed us that the fish production would be high though the average size of RUI is smaller as compared with last year. Most of the fishermen are living with their family in khola. Female persons are doing a lot of supporting works of fishing activity. The share/ salary of a fisherman depends on the participation of his wife in the relative activity.

The management area may be designated as the field office campus of the lessee where field manager, cashier, paharader are living together with all necessary goods(foods, cloths , guns, fuel, engine boat etc). At present 40 paharaders are working in the beel. They also set one sub station adjacent to the Ahmakkhali. Paharaders are working 24 hours to protect the subsistence fishing.

TILKHOI FISHERY

Tilkhoi fishery is the part of Beheli river fishery where they fish annually. They install Katha 4 months before and started harvesting on 20 January 1993. Fishing will continue for 4 - 5 days and then Katha will be placed for further fishing (after 20 - 25 days). This process will continue up to early April until they confirm that no fish is there. The lessee hires two genuine fishermen from Doarabajar who can fish from 15 - 20 m depth but their demand is much higher than the other skilled fishermen.

Gang fishing is a local name of illegal fishing in a particular beel or haor by some organized unauthorized fishermen. NERP met with a leader of one gang fishing group (who was in Jail for three years). As per his report following are the reasons for Gang fishing:

- local fishermen/men are not getting the lease.
- lessee does not allow the local people for subsistence fishing during monsoon.
- no job opportunity during monsoon.

- conflict between two interested group.

In Shanir haor such type of occurrence was observed on 12 - 14 November 1992 in the Shanirua group fishery by the lessee of Chatol group Fishery due to internal conflict among them. About 35 - 40 fishermen were hired from Harinagar and Radhanagar. They used about 15 boats to fish mostly with Current/Gill nets. The lessee of the Shanirua lost about tk 50,000 due to the gang fishing. Both the parties filed a criminal case against their opponent in the Jamalgonj police office.

February-April 1993: Annual beel fishing was finished earlier this year due to early heavy rain, which didn't allow them to fish properly (this might be the cause of better production next year). The leader of the fishermen Mr Sudangshu Chakraborti reported that about 25-35 % fish can not be harvested due to two flash floods during the dry season. The Khola of Boigani group fishery are now in the removal process. They are resetting the Katha for next years harvest. The total estimated harvest of the Boigani haor is noted as follows:

Table E37: Catch Estimate, Boigani Haor

Gear or Fishing Method	No of Units	Daily Catch per Unit	Fishing Days	Total Catch
Chouhanda(Chat)	30	5 Kg	60	9,000 Kg
Kona jal	1	50 Kg	60	3,000 Kg
Dol fishing Twice/season	4	8,000 2,000		32,000 Kg 8,000 Kg
Gill net		20 Kg	60	1,200 Kg
Khora Jal	3	5 Kg	60/2	450 Kg
GRAND TOTAL WEIGHT =				53,650 Kg

Winter of 1993-94

November-December 1993: Main Beel fishing will start during the last week of the January 1994. The lessee has started installation of Khola near the respective beel. A group of efficient fishermen composed of 15 Koibarta from Lakhai hired by the lessee of Boigani Haor have started the following works:

- Preparation of Khola.
- Closing of Chanals and different cuts.
- Setting of Katha/Dols.
- Preparation of other equipments.

During the reporting period they completed the following steps:

- One temporary shed.
- Closed 4 points (Canal near regulator, Cutting points near Ramjibanpur, Putichora, Ahmakhali)

Small beel fishing in the Putichora beel area, Shaniroa and Chatal beel were started during 1st week of December.

January 1994: Beel fishing started from 22nd January. Mr. Madhu Das from Lakhai thana made a contract with the lessee to harvest fish from the fishery. About 250 people are residing in the Khola among which about 150 are fishermen and the others are family members or management workers. Fishermen groups are divided into different sections on the basis of harvesting process which are as follows:

Table E38: Fishermen Groups

Gear	No of Groups	No of Fishermen
Chouhanda	21	64 + family members
Dol fishing	1	50
Ber jal	3	24

Fishing was completed in the Putichora group fishery, Shanirua beel, Chatol group fishery during this reporting period while fishing in the Dawa beel is continuing. About 12 fishermen groups are fishing in Dhawa beel. The different types of fishing in Dhawa beel are noted below.

Table E39: Types of Fishing in Dhawa Beel

Gear	No of Groups
Dol fishing	1
Uther jal	2
Chouhanda	1
Kona jal	1

February 1994: Fishing in the most shallow beels in the Shanir Haor area already been completed. Fishing in the Boigani Group Fishery and Dhawa beel continued.

About 75% of the fishing has been completed in the Dhawa beel. About 5000 kg fish were harvested from Dhawa beel up to 21 February 1994. The lessee assumed that about 80% of the fish have already been harvested. Following are the catch details by the gear used:

Table E40: Catch Data for Dhawa Beel

Gear	Species	Value (tk)	Weight (kg)
Dol fishing	Large species	50,000	1,250
Kona jal	Small species	31,000	1,240
Chouhanda	40% large species; 40% catfish; 20% small species	45,000	1,427
Gill net	Small species	25,000	1,000
TOTAL =		151,000	4,917

Large fish include air, gonia, kalibaush, boal, gajar and foli. Small fish include puti, bazari tengra, tengra, baila, shinghi.

At Boigani group Fishery, there are 21 Chot, 3 Kona, 20 Kg gill net and 1 group of Dolnet are harvesting fish from the fishery. Starting from 22 January 1994 fishing is continuous (no gaps). Harvested fish were calculated on the basis of aggregated sale proceeds of fish caught by different gears. Harvested fish are sold in two ways (1) relatively small fishes are sold to the local Nikery, (2) Larger fishes are sold on a contract basis. The value of daily small fish catch varies from Tk 15,000 to Tk 30,000. Average price of one kilogram fish was about Tk30. Larger fish are transported to Dhaka by Cargo boat having an insulated facility with ice. About 20t fish are transported by 4 trips up to this reporting time. Transported fish composition were 80% RUI, 5% KALIBAUSH, 5% GONIA, 5% BOAL and others are 5%. Women in the Khola were engaged in fish drying and about 20 units are working.

Beel production from shanir Haor was estimated as follows:

Boigani Group Fishery (440.1ha)

Local auction:

22 to 31 January (10 days) @Tk 15,000/day and @Tk 30/kg = 5,000kg
1 to 28 February (28 days) @Tk 20,000/day and @Tk 30/kg = 18,667kg
1 to 31 March (31 days) @Tk 15,000/day and @Tk 30/kg = 15,500kg

Fish transported by Cargo Boat to Dhaka was:

Shift	Weight (kg)
1 (1st week of Feb.)	8,000
2 (2nd week of Feb.)	7,000
3 (3rd week of Feb.)	7,000
4 (3rd week of Feb.)	5,000
5 (4th week of Feb.)	3,000
6 (1st week of Mar.)	2,000
TOTAL =	32,000kg

Total production is 71,167kg (equal to 162 kg/ha)

Dhawa Beel (22.62ha): (up to 21 Feb)

Dol Fishing(Large fish) =	1250kg
Konajal (small fish) =	1240kg
Chouhanda(L40%+C40%+S20%) =	1427kg
Gill net (small fish) =	1000kg
TOTAL =	4917kg

Total production is around 5000 kg (equal to 221kg/ha).

Estimated total production of beels inside the project is 78,356.37kg.

Fish production estimates

Estimation of fish production in the floodplain is difficult due to several types of constraints involved with the production. During our monitoring work in last few months, we observed that the catch/haul is different in size depending on season, time, location and fishing skills. It was also difficult to estimate the number of fishermen , the number of fishing days, the number of gears and the number of gear-days.

However, using the frame survey and catch information collected during the monitoring period, an estimate of fish catch has been made, by type of gear. Fishing days and gear days are calculated on the basis of fishing/gear intensity during different months. The average standing crop of the floodplain of Shanir haor is estimated on the basis of NERP sampling records of different months.

YEAR 1: May 1992 - April 1993

Floodplain Production during Monsoon:

Table E41: Catch by Kona Jal (1992 monsoon season)

Month	No of Units	Catch per Haul (kg)	Hauls per Day	Fishing Days	Total Catch (kg)
June	30	6.0	12	28	60480
July	40	6.0	12	28	80640
Aug	46	5.0	12	28	77280
Sept	40	5.0	12	28	67200
Oct	30	4.0	12	28	40320
Nov	16	3.0	12	28	16128
GRAND TOTAL =					342048

Table E42: Catch by Gill net (1992 monsoon season)

Month	No of Units	Catch (kg) per Unit per Day	Fishing Days	Total Catch (kg)
July	125	4.00	20	10000
Aug	200	5.00	28	28000
Sept	274	5.34	25	36579
Oct	60	6.00	20	7200
Nov	25	6.00	10	1500
GRAND TOTAL =				83,279

Table E43: Catch by Hook & Line (1992 monsoon season)

Month	No of Units	Hooks per Unit	Catch (kg) per 100 Hooks	Fishing Days	Total Catch (kg)
June	20	950	0.15	20	570
July	80	950	0.20	25	3800
Aug	165	950	0.24	28	10533
Sept	165	950	0.24	25	9405
Oct	130	950	0.30	20	7410
Nov	15	950	0.30	10	428
GRAND TOTAL =					32146

Table E44: Catch by Traps (1992 monsoon season)

Month	No of Units	No per Unit	Catch per Unit (kg)	Fishing Days	Total Catch (kg)
June	8	75	5.25	25	1050
July	8	75	6.00	28	2344
Aug	8	75	7.50	28	1680
Sept	8	60	4.20	20	672
Oct	8	50	2.5	15	300
Nov	8	50	2.0	10	160
GRAND TOTAL CATCH =					6,206

Tela jal production is estimated to be 10% of total catch from the other four gears (= 46,600 kg).

Total catch by the five main gears is 510,000 kg (the catch of other gears is not included).

Beel Production during Dry Season: The estimated fish production from beels was 59,750 kg. Of this, the Boigani Group fishery production was 53,650 kg.

Total Annual Production: Total production during Year 1 (June 1992 - May 1993) is summarized in the following table:

Table E45: Annual Production (June 1992 to May 1993)

Season/Habitat	Gear	Production (tons)	
		tons	%
Monsoon / floodplain	Kona Jal	342.0	60.0%
	Gill nets	83.3	14.6%
	Hook & Line	32.1	5.6%
	Traps	6.2	1.1%
	Tela Jal	46.4	8.1%
Dry Season / Beels		59.8	10.5%
ANNUAL TOTAL =		569.8	100%

Yields per area: Average monsoon season floodplain yield from 6,677 ha is 76.4 kg/ha. The average standing crop during the monsoon determined by Kona Jal is 31.1 kg/ha, and by Ber jal is 14.3 kg/ha. Dry season beel yield from 475 ha is 121.8 kg/ha.

YEAR 2: May 1993 - May 1994

Floodplain Production during Monsoon:

Table E46: Catch by Kona Jal (1993 monsoon season)

Month	No of Units	Catch per haul (kg)	Hauls per day	Fishing Days	Total Catch (kg)
June	20	4.0	8	20	12,800
July	35	5.0	8	24	33,600
Aug	40	5.0	10	25	50,000
Sept	45	5.0	10	25	56,300
Oct	35	4.0	10	25	35,000
Nov	15	3.0	10	20	9,000
GRAND TOTAL =					196,700

Table E47: Catch by Gill net (1993 monsoon season)

Month	No of Units	Catch (kg) per Unit per Day	Fishing Days	Total Catch (kg)
June	150	3.0	25	11,300
July	200	4.5	25	22,500
Aug	300	6.0	20	36,000
Sept	350	6.0	25	52,500
Oct	200	5.0	20	20,000
Nov	125	3.0	15	5,600
GRAND TOTAL =				147,900

Table E48: Catch by Hook and Line (1993 monsoon season)

Month	No of Units	Hooks per Unit	Catch (kg) per 100 Hooks	Fishing Days	Total Catch (kg)
June	60	950	0.25	20	2,900
July	120	950	0.50	25	14,300
Aug	200	950	0.75	25	35,600
Sept	200	950	0.60	25	28,500
Oct	150	950	0.30	20	8,600
Nov	50	950	0.15	15	1,100
GRAND TOTAL =					91,000

Table E49: Catch by Traps (1993 monsoon season)

Month	No of Units	No per Unit	Catch per Unit (kg)	Fishing Days	Total Catch (kg)
June	25	15	0.5	25	4,700
July	30	20	0.5	25	7,500
Aug	30	20	0.7	28	11,800
Sept	35	25	0.7	28	17,100
Oct	40	25	1.0	28	28,000
Nov	40	25	1.0	28	28,000
GRAND TOTAL =					97,100

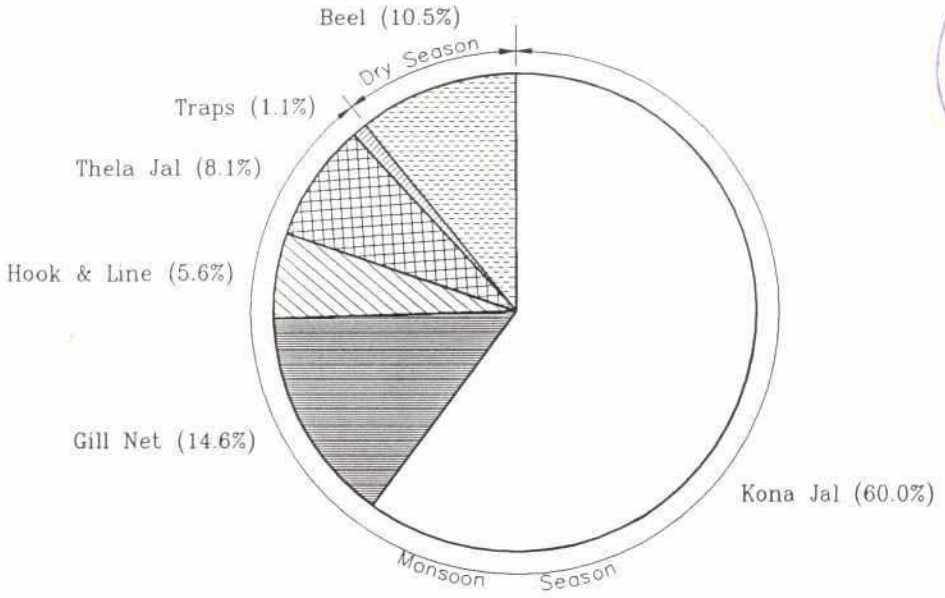
Table E50: Catch by Thelajal (1993 monsoon season)

Month	No of Units	Catch per Unit (kg)	Fishing Days	Total Catch (kg)
June	500	0.5	20	5,000
July	700	0.5	25	8,800
Aug	725	0.75	25	13,600
Sept	700	0.75	25	13,100
Oct	600	0.70	25	10,500
Nov	500	0.50	25	6,200
GRAND TOTAL =				57,200

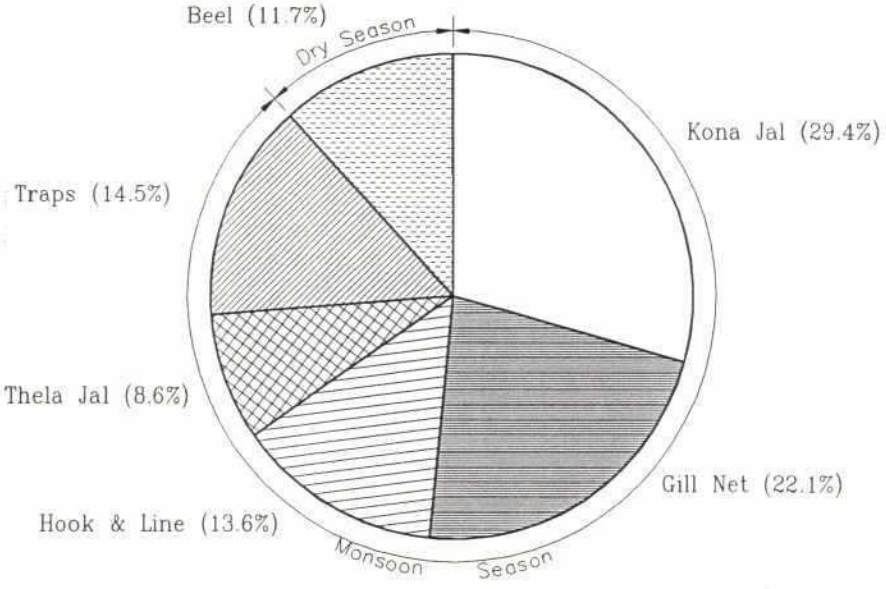
Total catch by the five main gears is 589,900 kg (the catch of other gears is not included).

Beel Production during Dry Season: Estimated total production of beels inside the project is 78,356 kg.

Figures on fish production are shown on the following three pages: (1) The comparison of fishing gear and production, (2) comparison of production for years 1 and 2, and (3) relationship between production and flood intensity.

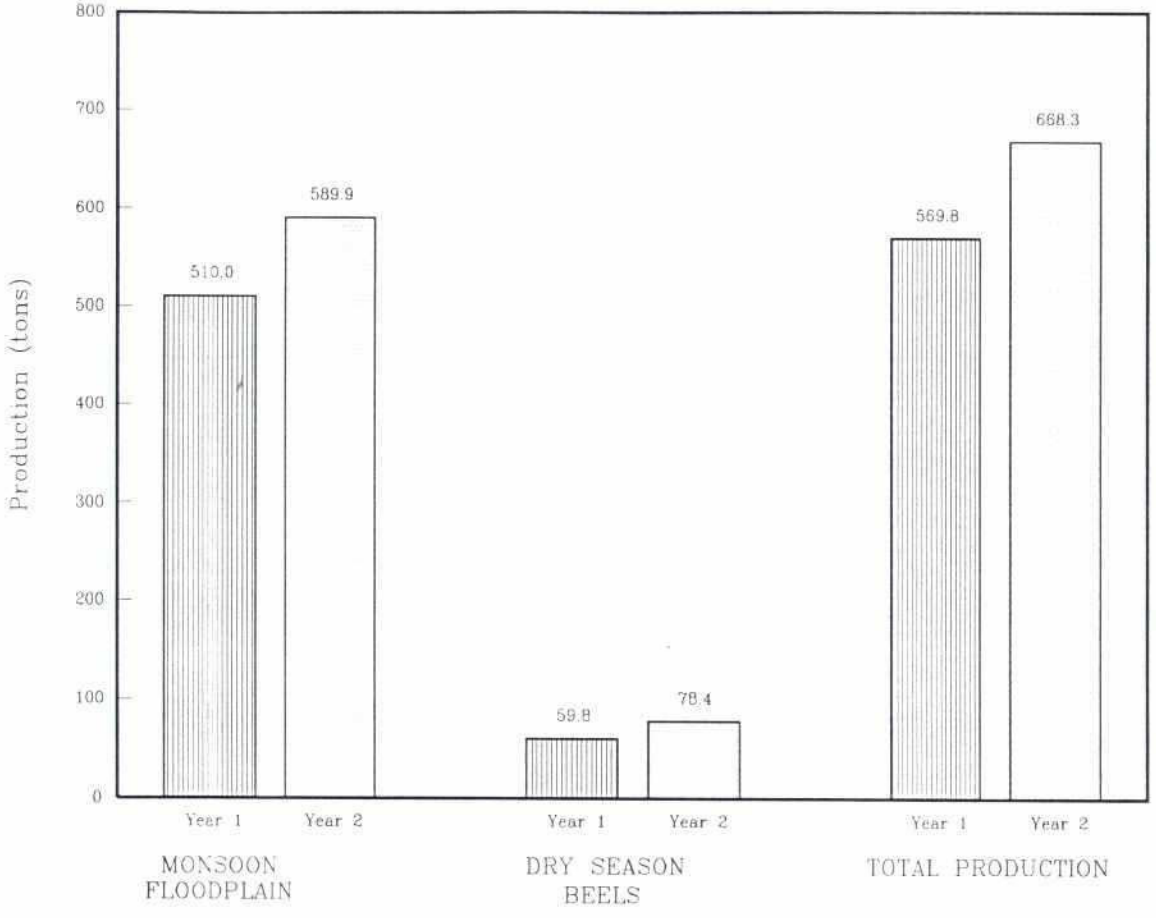


YEAR 1

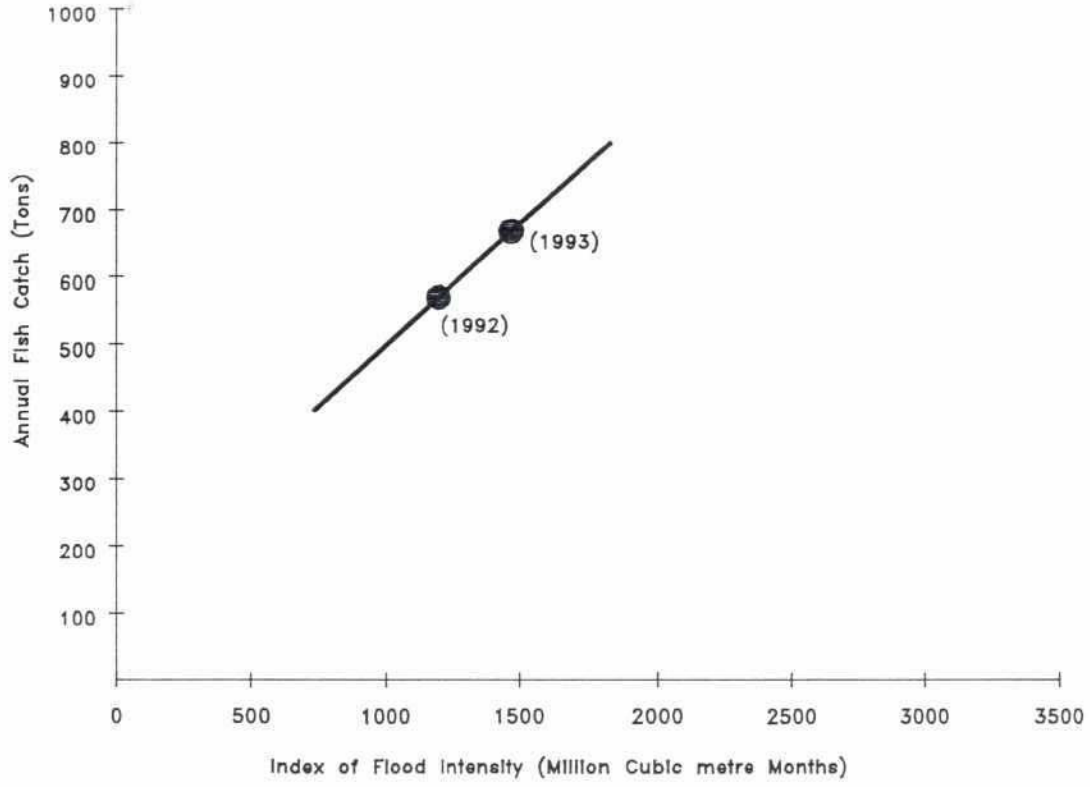


YEAR 2

Comparision of relative contribution of various Fishing Gears and Beel production to total production in year-1 & year-2 at Shanir Haor FCD Project



COMPARISON OF FISH PRODUCTION BETWEEN YEAR 1 & YEAR 2
IN SHANIR HAOR FCD PROJECT



Relationship between flood intensity and fish production at Shanir Haor

Total Annual Production: Total production during Year 2 (June 1993 - May 1994) is summarized in the following table:

Table E51: Annual Production (June '93 to May '94)

Season / Habitat	Gear	Production (tons)	
		tons	%
Monsoon / floodplain	Kona Jal	196.7	29.4%
	Gill nets	147.9	22.1%
	Hook & Line	91.0	13.6%
	Traps	97.1	14.5%
	Tela Jal	57.2	8.6%
Dry Season / Beels		78.4	11.7%
ANNUAL TOTAL =		668.3	100%

Yields per area: Average monsoon season floodplain yield from 6,677 ha is 88.3 kg/ha. The average standing crop during the monsoon determined by Kona Jal is 15.8 kg/ha, and by Ber jal is 8.8 kg/ha. Dry season beel yield from 475 ha is 164.6 kg/ha.

INTERYEAR COMPARISON

Comparison of production, yields and flood intensity between years 1 and 2 is given in the following table:

Table E52: Production Summary

	Season & Habitat	YEAR 1 (May 92-April 93)	YEAR 2 (May 93-May 94)	% Change
PRODUCTION	Monsoon Floodplain	510.0 t	589.9 t	+ 15.7%
	Dry season beels	59.8 t	78.4 t	+ 31.1%
	TOTAL =	569.8 t	668.3 t	+ 17.3%
YIELD	Monsoon Floodplain	76.4 kg/ha	88.3 kg/ha	+ 15.6%
	Dry season beels	121.8 kg/ha	164.6 kg/ha	+ 35.1%
FLOOD INTENSITY*	Entire haor	1,195 mcm-months	1,469 mcm-months	+ 22.9%

* An index of flood intensity was calculated as the area under the flood volumes curves presented in Section 4.1 and in Appendix A.

Fish processing

As Shanir haor is located in a remote area, no fish processing mechanism has been developed. People mostly use fresh fish. When they harvest a large fish they try to supply it fresh directly to the market. If it seems to be more than market consumption they try to prepare it as dried fish. It was observed that some Nikery ice their fish.

From October fishermen had begun drying fish. They build up high wooden platform in the open field (for direct sun drying) covered by nets (like a tent) to protect fish from birds and animals during the drying process. The fishermen dry fish for the following reasons:

- to prevent losses due to a large catch
- to not sell when market prices are low
- to make more money during the lean season.

To increase their profits by supplying live fish to the market, Nikery have developed a unique mechanism in their fish carrying boats by making a hole in the one side of the boat to create a regular current within the boat. Water gets in through the hole and one man manually drains out the excess water from the boat. Before loading the boat, they place the live fish in a trap which is set under water.

During Beel fishing it was observed that the fishermen stock harvested fish in a basket to keep them alive until marketing. Normally they set the net on the surface water level to facilitate fish movement.

The fishermen of different Khola are drying small fish which are not easy to market.

January 1993: They stock harvested fish in a basket to keep them alive until marketing. Nikery purchase fish from the Katha and supply to the market. The fishermen of Boigani Khola are drying some fish which were caught from other beels on a contract basis.

November-December 1993: Fish drying started from October when the weather became less humid and a maximum fish catch was possible due to rapid fall in water levels. Most of the fishermen have been trying to catch more fish as the weather is suitable for drying. KAIKKYA, CHANDA, ICHA, BHEDA, PUTI, BAIM, SHOAL, GAZAR,KECHKI and CHAPILA are the main fish used in drying.

To make more profit fishermen are trying to keep fish alive for a long period. They stock fish carefully in a bamboo/ net made basket where fish can swim for a certain period.

January 1994: Starting from October, fishermen are drying fish which are transported to the Shachna Bazar, Biswambarpur market for retail or whole sale. During beel fishing and Neem fishing fishermen stock their harvested fish in a basket partially submerged in water.

February 1994: Fish drying is the main processing system in the Haor area. Big fishes of Boigani group Fishery are transported by an insulated Cargo boat.

Fish markets and prices

There are four permanent markets (Taherpur, Beheli, Anwerpur and Kidderpur) in Shanir haor where fish are sold mostly 2 days in a week. Among them only the Taherpur market sells fish

on a daily basis. Most of the catches are sold out to Nikery in the floating market or to the people living in the adjacent village. Following are the observations on market prices for different available species in different seasons.

June 1992: Fish prices were very low. Normally fisherman barter fish (MOLA and CHANDA) to the villagers directly, moving from door to door. The barter rate is 0.5 kg of rice for 1.0 kg of fish. Other fish are sold to NIKARI (who supply fish to Sunamgonj and Sylhet) at a floating market near Taherpur (Suklargaon). A very few fish was observed in the Beheli fish market during the weekly market day.

July/August 1992: Fish market/price patterns remain unchanged for July in comparison with the previous month. Only the size of fish increased (Mola, Chela, Chanda) slightly. The fishermen were observed to receive a better price for fish in August due to competition among NIKERI. Morning and evening is a good time for marketing when most Nikery try to purchase fish.

September 1992: The prices of small fish (CHOTOMAACH harvested with KONA JALs) remained the same as the previous month. The prices of large fish (BOROMAACH) are increasing due to a shortage of supply.

October-November 1992: Several markets were visited to check the fish supply and prices. It was observed during this period that Taherpur fish market is an exceptional fish market from where one can buy fish at any time any day. Market day is wednesday and on that day the fish supply is larger than on other days. Floating Nikery fish markets were visited at Islampur (7 Nov and 10 Nov) and at Gopalpur (10 Nov). Gopalpur is outside the project area, east of Beheli in Halir haor. The nikery purchase fish at Islampur, but both purchase and sell fish at Gopalpur. We observed a significant variation of price from day to day and market to market. The average price of 1 kg of fish (mostly live) in Islampur on 7 Nov was aprox. Tk 30 and in 10 Nov Tk 35.

A paiker, who hire a mechanized boat fitted with an insulated box and ice, comes to Gopalpur (easy accessible by boat from both Jamalgonj and Sunamgonj) to purchase fish from the Nikery. He has a monopoly business there. We observed some Nikery unwillingly selling his fishes to the Paiker, and some other Nikery left for Jamalgonj market.

One Nikery purchased 15 CHITAL (1.0 - 1.6 kg/ fish) from the Khola Chanpur (catch from Nandin gang), which was an exceptional catch. He refused an offer of Tk.1200 for the 15 CHITAL, and asked for Tk 2,000. Some big BOAL (2.75kg) and AIR(2.5 kg) were observed in the market which were caught from the Nandin river.

January 1993: In comparison with the other month fish supply was less (down by about 60%). Only beel fishing is the main source of fish in the market. A few fish are coming from river catch. Local dry fish is dominating the market.

There was no floating market as observed in the previous month. During our visit to Taherpur fish market on 13 January 1993 we observed only three types (PUNTI, KAIKKYA, LACHU) of fresh fish while there were 10 types (PUNTI, TAKI, KAIKKYA,, BATA, LACHU, CHANDA, ICHA, BAJARI TENGRA, JATPUNTI) of dry fish.

February-April 1993: Depending on the abundance of Uzaia fish two emergency floating markets were developed, one in Beheli ferry ghat and other in Solemanpur, where Nikery brought some

ice to maintain the quality of fish. Fishes mainly from Shanir haor, and Halir haor are the main source to the Beheli market, from where 2-3 boats (800-1000 Kg/day) were carried to Sunamgonj(from 24-30 April). The fishes from Tangua and Matian haor were brought to Solemanpur, where a group of Nikery purchase fish and supplied to Sylhet. Every day (24-30 April) average supply was 1600 - 1800 kg.

May 1993: After Uzaia, a very few fish were observed in the regular market, the emergency fish market was already withdrawn, just after uzaia. The people are not easily getting fish for their consumption.

June 1993: Taherpur, Beheli and Kiddirpur weekly markets were visited during this period. Most of the marketed fish are small or juvenile (catch of Kona jal). Relatively large fishes are purchased and then carried to Sunamgonj or Sylhet by Nikery.

July 1993: Juvenile small fish dominated the fish market during this reporting period. Most of the fish are the catch of Kona jal.

August 1993: Most of the fish in the Taherpur and Beheli market were very small while large fishes (RUI, BOAL, KALIBAUSH) were observed in the floating market eg. Islampur floating fish arat, Gopalpur floating fish market etc.

September 1993: The big fishes were sold out to the Nikary who transported them directly to the Sunamganj and Sylhet market. The local markets were dominated by small fishes.

November-December 1993: Due to water levels receding floating fish markets are fixed in three different places (Solamanpur, Beheli Alipur bazar and Abua river adjacent to Berkuri). Two/three Nikari control the markets having engine boats with ice facilities. Dry fish are available in the regular markets.

February 1994: Large fish from Boigani Fishery are transported directly to the Soarighat, Dhaka to maximize their profit. Insulated carriers having sufficient ice stocking facilities are used as the carrying vessel of fish from Shanir Haor. The Khola manager reported that more than 20 tonnes of fish were transported to Dhaka by four trips. Small fish are sold through open auction in Khola. About 20 Nikery gathered to purchase fish from the Khola but 4-5 Nikeries had engine boats with ice facilities and they purchased most of the catch. Most of the illegal catch are sold in the Islampur floating arat.

Table E53: Shanir Haor Fish Prices (June 1992-May 1993)

SPECIES	J	J	A	S	O	N	D	J	F	M	A	M
RUI					40	35			70	70	70	
KALIBAUSH			25		30	30						
GONIA			35		30	30			50	55	60	
BOAL									50	50	50	50
TENGRA	20		25		15	20						
AIR									55	55	60	65
PABDA	30		45		25	30						70
GULSHA					40	45						
BAIM	20		35		35	30						
LATI	15		30		20	15						35
GOZAR					25	30						
SHOAL									45	50	50	50
SHINGI					45	45						
MAGUR					45	50						
LACHU					25	20		40				
PUNTI					25	30		10				
MOLA	5		10		20	15						
CHANDA	4		10		20	15						
KAIKKYA					20	25		35				
CHITAL					50	45						
PHOLI					25	30						
CHAPILA					30	25						
KECHKI					25	25						
ICHA					10	10						
Small fish									50	50	50	20

Table E54: Shanir Haor Fish Prices (June 1993-May 1994)

SPECIES	J	J	A	S	O	N	D	J	F	M	A	M
RUI		70	75	60		70	60		60			
KALIBAUSH	45	50	45	40		40	45		40			
GONIA	55						45		40			
BOAL	50			40					45			
TENGRA	30	30	35	20			30					
AIR									55			
PABDA	66	65										
GULSHA		45										
BAIM			40	30		40			35			
LATI												
GOZAR												
SHOAL				40								
SHINGI	55					40	45					
MAGUR												
LACHU												
PUNTI	25		25			25	25					
MOLA												
CHANDA												
KAIKKYA	25		20	15		25						
CHITAL												
PHOLI				25								
CHAPILA				20		30	25					
KECHKI												
ICHA	10		10	10		10	10					
Small fish	15		15	15		15	15					

APPENDIX F

FORESTRY DATA

APPENDIX F : FORESTRY DATA

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F.1 FRESHWATER SWAMP FOREST PATCHES WITHIN SHANIR HAOR

Table F1: Freshwater Swamp Forest Patches

Locality	Area (ha)	Dominant Species	Management System
Uttar Fatehpur/ Shahapur	4.0	Koroch/Hizal	Private
Ratansree	2.0	Koroch/Hizal	Mosque-based
Rajendrapur	4.9	Koroch/Hizal	Leased
Nayanagar	1.2	Koroch	Leased/Private
Marala	1.2	Koroch	Leased/Private
Gopalpur	2.0	Koroch	Mosque-based

F.2 LOCAL INITIATIVES FOR FOREST CONSERVATION

Plantation of some water-tolerant plants (*koroch* and *hizal*) around villages near Marala and Islampur (privately arranged) and Gopalpur (= Jalalpur) (under community management). There are two patches at Gopalpur and Ratansree under community management. Most of these patches are dominated by *koroch* with a few solitary *hizal*. The management is mosque-based, with the mosque committee making all the decisions. All the income through selling *koroch* branches and saplings are utilised for the renovation/management of the mosque.

It has been reported in November 1993 that the people of Marala decided to conserve forest (bon), mainly *hizal* and *koroch* trees adjacent to the kanda of their village. In connection with this, they collectively formed a committee comprising 12 members. This committee would also function as the Masjid Committee. Some decisions were taken by this committee.

- The kanda which is located in the middle of Nayanagar and Marala was declared as protected area for forest.
- If someone cut grass or trees or any other thing of forest in this kanda, one would have to pay a penalty of Tk 100.

(202)

- These decisions would remain applicable for five years.
- At any time, the committee can add new provisions for the conservation of forest. They can use the forest products as fuel or for baribandha when these would be matured.

Some households of the villages of Islampur, Moshalghat and Rajendrapur are planting the *koroch* trees adjacent to their homesteads. They purchased saplings from the traders from Kalmakanda.

F.3 MANAGEMENT PRACTICES OF SWAMP FOREST AND FUTURE PROSPECTS

Ratansree Forest Grove: This swamp forest patch is managed by the village mosque committee. The committee leases it out and all the proceedings go to the mosque fund which are utilized for the maintenance of the mosque. No single person has been appointed to take care, but all the villagers collectively look after it. As a result many of the trees are either dying or need proper nursing. During the monsoon floods due to erosion the roots of the trees are exposed which leave them in a vulnerable state. Several attempts were taken to cover the roots with soil but every time the soil was removed by unidentified persons.

To improve the forest the villagers planted about 600 *koroch* saplings in December 1992. During regular surveys in 1993 a record was kept of the number of surviving saplings. Presently only $\pm$ 250 tree saplings survive along with the older trees. Most of the saplings died because of the lack of proper care. Among the existing patches, this one is somehow doing well because some people in the committee are really interested to improve it.

Rajendrapur Forest Grove: This patch is leased by the local government office under revenue department. The exact amount of the lease money is not known. 10 - 15 trees die each year and are sold by the lease holder. No attention is paid by the lease holder as to the maintenance of the grove. A guard is deployed only to arrest unauthorised cutting/theft. Lack of maintenance is the main reason for the depletion of this patch and almost 60 % of the number of trees have decreased during the last ten years. Presently there are 170-180 *koroch* trees and 20 decapitated *hizal* trees. Most of the *hizal* trees are old and in poor condition.

Nayanagar/Marala Forest Grove: Nayanagar grove is a small patch, about 3 acres, and continues with the adjacent Marala forest grove, 3 acres. The total area of this patch stands at 6 acres. A little portion 0.5 acre is privately owned, and the rest is leased by the local authorities. A local villager is employed by the leasee to guard the trees. The villagers violently protested against cutting of trees by the lessee. Only some branches are harvested annually. The villagers understand the value of the trees since both Nayanagar and Marala are located on the erosion prone corner of Shanir Haor. Presently there are 125 *koroch* trees in this patch.

Uttar Fatehpur/Shahapur Forest Grove: This is privately managed, consisting mostly of *koroch* trees. The patch is in good condition and several guards are appointed to protect the trees against illegal cutting. The total area is around 10 acres.

The present trend of management practice indicate lack of interest among the managers in taking proper care and maintaining the forest patches. The value of the trees are understood by the people residing in the lowlands but little initiatives are taken by them to improve the management standards.

Table F2: Checklist of Trees with Local Names

Scientific Name	Family	Local Name
Swamp Forest		
Barringtonia acutangula	Lecythidaceae	Hijal
Crataeva nurvala	Capparidaceae	Barun
Pongamia pinnata	Papilionoideae	Koroch
Salix tetrasperma	Salicaceae	Bias,Panihijal
Trewia nudiflora	Euphorbiaceae	Gotagamar,Panidumur
Homestead		
Aegle marmelos	Rutaceae	Bel
Alstonia scholaris	Apocunaceae	Chatim
Albizia sp.	Leguminosae	Koroi
Albizia procera	Leguminosae	Sadakorai,Silkorai
Anthocephalus chinensis	Rubiaceae	Kadom
Areca catechu	Palmae	Supari
Artocarpus heterophyllus	Moraceae	Khatal
Azadirachta indica	Meliaceae	Nim
Bombax ceiba	Bombacaceae	Shimul
Bambusa sp.	Gramineae	Bans
Cassia siamea	Leguminosae	Minjuri,Eskikoroi
Caryota urens	Palmae	Bansupari,Chaur
Cocos nucifera	Palmae	Natrikal
Diospyros perigrina	Ebenaceae	Gab,Deshigab
Erythrina variegata	Leguminosae	Mander,Piltamander
Erythrina ovalifolia	Leguminosae	Talimander
Ficus benghalensis	Moraceae	Bot
Ficus religiosa	Moraceae	Assawath
Ficus hispida	Moraceae	Dumur
Lagerstromia speciosa	Lythraceae	Jarul
Mangifera indica	Anacardiaceae	Am
Musa paradisiaca		
var. *sapientum*	Musaceae	Kala

Table F2: Checklist of Trees with Local Names (Cont'd)

Scientific Name	Family	Local Name
Samanea saman	Leguminosae	Rendi,Raintree
Syzygium fruticosa	Myrtaceae	Khudijam
Syzygium cumini	Myrtaceae	Kalojam
Terminalia catappa	Combretaceae	Katbadam,Deshibadam
Temarindus indica	Leguminosae	Tentul
Zizyphus mauritiana	Rhamnaceae	Boroi,Kul

Table F3 Uses of Different Tree Species

SPECIES	USES
Swamp Forest	
Barringtonia acutangula	TS,FU,FT,M
Crataeva nurvala	TS,FU
Phyllanthus disticha	M,FU
Pongamia pinnata	TS,FU,OT,M
Salix tetrasperma	TS,FU
Trewia nudiflora	TS,FU,M
Homestead	
Aegel marmelos	C,M,FF,TS
Alstonia scholaris	TS,FU,M
Albizia sp.	TS
Albizia procera	TS
Alpinia sp.	M,OR
Anthocephalus chinensis	TS,FU
Areca catechu	FF,TS,M
Artocarpus heterophyllus	FF,TS
Bombax ceiba	TS,FB,FU,M,EX
Bambusa sp.	TS,FB,FU,FV,OT
Cassia siamea	FU,TS
Caryota urens	OR,TS,B
Centella asitica	M,FV
Cleorodendrum siphonanthes	OR,FU
Cocos nucifera	FF,TS,FB,VO
Datura suaveolens	M
Diospyros perigrina	FF,EX,M,DT
Erythrina variegata	FU,OR,M
Erythrina ovalifolia	FU,OR,M
Ficus bengalensis	FU,C,OT,M
Ficus rumphii	FU,TS
Ficus religiosa	C,FU,TS,OT,M

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Table F3 Uses of Different Tree Species (Cont'd)

SPECIES	USES
Ficus hispida	FV,TS
Ficus sp.	FU,M
Lagerstromia speciosa	TS,OR,FU
Mangifera indica	FF,TS,FU,M
Mikania scandens	M,FP
Mikania cordata	M,FP
Musa paradisiaca var. *sapientum*	FF,FV
Ocimum americanum	M,C
Pandanus sp.	FB
Samanea saman	TS,FU
Syzygium fruticosa	FF,TS,FU
Syzygium cumini	FF,TS,EX,M
Tamarindus indica	FF,FU,M
Terminalia catappa	TS,FF,M
Zizyphus mauritiana	FF,FU

Uses :
M- medicinal/narcotic/poison; C- ceremonial; FF- food: fruit & nuts;
FS- food:starch/sugar/cereals; FV- food: vegetable; B- beverages;
VO- vegetable oils; SF- spices/flavours; EO- essential oils; FU- fuel;
SM- smoking/chewing; FP- feed plants/forage; DT- dyes; OR- ornament/hedge;
TS- timber/structures; EX- exudates/resins; FB- fiber/thatching/wickerwork;
FT- fish entrenchment; BF- bio-fertilizer; BG-bio gas; OT- other uses.

APPENDIX G

BIODIVERSITY INVENTORY

APPENDIX G : BIODIVERSITY INVENTORY

INDEX

Table G1: Checklist of Plants with Local Names, Family and Habit

Scientific Name	Family	Local Name	Habit
Submerged			
Aponogeton natans	Aponogetonaceae	Ghechu	H,Pe
Aponogeton undulatus	Aponogotonaceae	Ghechu	H,Pe
Aponogeton appendiculatus	Aponogetonaceae	Ghechu	H,Pe
Ceratophyllum submersum	Ceratophyllaceae	Jhangi	H,Pe
Hydrilla verticillata	Hydrocharitaceae	Kureli,Jhangi	H,Pe
Myriophyllum tuberculatum	Haloraceae	--	H,A
Myriophyllum tetrandrum	Haloraceae	--	H,A
Najas sp.	Najadaceae	Goisa	H,A
Ottelia alismoides	Hydrocharitaceae	Panikola,Kaorali	H,A/Pe
Potamogeton crispus	Potamogetonaceae	Keorali	H,Pe
Potamogeton mucronatus	Potamogetonaceae	Keorali	H,Pe
Rotala rutundifolia	Lythraceae	--	H,A
Sagittaria guayanensis spp *lappula*	Alismataceae	Muamia, Kaowathukri	H,Pe
Sagittaria sagittifolia	Alismataceae	Chhotokul	H,Pe
Vallisnaria spiralis	Hydrocharitaceae	Pataseola, Bicha	H,A/Pe
Free Floating			
Azolla pinnata	Salviniaceae	Kutipana	H,Pe
Eichhornia crassipes	Pontederiaceae	Kochuripana	H,Pe
Lemna perpusilla	Lemnaceae	Khudipana	H,Pe
Pistia stratiotes	Araceae	Topapana	H,Pe
Salvinia cucullata	Salviniaceae	Kuripana,Indurkan	H,Pe

Table G1: Checklist of Plants with Local Names, Family and Habit (Cont'd)

Scientific Name	Family	Local Name	Habit
Salvinia natans	Salviniaceae	Tetulapana	H,Pe
Spirodela polyrhiza	Lemnaceae	Khudipana	H,Pe
Utricularia exoleata	Lentibulariaceae	Chhotojhangi	H,A
Wolffia arrhiza	Lemnaceae	Guripana	H,Pe
Rooted Floating			
Echinochloa colonum	Gramineae	Parua	H,A/Pe
Hygroryza aristata	Gramineae	Phutki	H,Pe
Limnophila sessiliflora	Scrophulariaceae	Bijatighash	H,A
Limnophila heterophylla	Scrophulariaceae	Karpur	H,A
Nymphaea nouchali	Nymphaeaceae	Sada,raktoshapla	H,Pe
Nymphoides cristatum	Menyanthaceae	Chandmala	H,Pe
Nymphoides indicum	Menyanthaceae	Panchuli	H,Pe
Panicum paludosum	Gramineae	--	H,A
Trapa maximowiczii	Trapaceae	Singra,Paniphal	H,Pe
Sedges & Meadows			
Alternanthera philoxeroides	Amaranthaceae	Helencha	H,A
Arundo donax	Gramineae	Baranal,Gobanal	H,A
Cleome hasslerana	Capparidaceae	Nunirleta,Hurhuri	H,A
Clinogyne dichotoma	Marantaceae	Sital-pati	S,Pe
Colocasia esculenta	Araceae	Kachu	H,Pe
Cyperus sp.	Cyperaceae	Mutha	H,A
Eclipta alba	Compositae	Kalokeshi,Kalohuza	H,A/Pe
Eleocharis dulcis	Cyperaceae	Panichaise	H,A
Fimbristylis dichotoma	Cyperaceae	Joina chaise	H,Pe
Fimbristylis miliacea	Cyperaceae	Joina,Chatkighash	H,A
Hemarthria protensa	Gramineae	Chailla	H,A
Ipomoea aquatica	Convolvulaceae	Kalmi shak	H,Pe
Ipomoea fistulosa	Convolvulaceae	Dhol kalmi	S,Pe
Ludwigia abscendens	Onagraceae	Kesardam,Mulcha	H,A
Ludwigia repens	Onagraceae	Panidoga	H,A

Table G1: Checklist of Plants with Local Names, Family and Habit (Cont'd)

Scientific Name	Family	Local Name	Habit
Monochoria hastata	Pontaderiaceae	Baranukha,Kechur	H,Pe
Polygonum glabrum	Polygonaceae	Bishkatali,Kukra	H,A
Polygonum lanatum	Polygonaceae	Kukra	H,A
Polygonum pedunculare	Polygonaceae	Kukra	H,A
Polygonum barbatum	Polygonaceae	Bishkatali	H,A
Rumex maritimus	Polygonaceae	Bonpalong	H,A
Schoenoplectus articulatus	Cyperaceae	--	H,A
Scirpus juncoides	Cyperaceae	Chisra	H,Pe
Sclerostachya fusca	Gramineae	Khuri	H,A
Sesbania roxburghii	Leguminosae	Huli,Phuli	S,A
Vetiveria zizanioides	Gramineae	Binna,Gandhabena	H,Pe
Xanthium indicum	Compositae	Ghagra,Khagra	H,A
Crop Field			
Alternanthera sessilis	Amaranthaceae	Haicha,Sachishak	H,A
Amaranthus spinosus	Amaranthaceae	Kata note	H,A
Ceratopteris thalictroides	Parkeriaceae	-	H,A
Chenopodium ambrosoides	Chenopodiaceae	Chapali ghash	H,A
Cotula hemispherica	Compositae	Kancha ghash	H,A
Croton bonplandianum	Euphorbiaceae	Morchaagra,Banjhal	H,A
Cynodon dactylon	Gramineae	Durba	H,A
Cyperus cephalotes	Cyperaceae	Niratraba	H,A/Pe
Centipeda orbicularis	Compositae	Machiti,Hachuti	H,A
Dentella repens	Rubiaceae	Sadaphuli,Sadajabri	H,Pe
Digitaria longiflora	Gramineae	Chota fulka	H,A/Pe
Eleocharis atropurpurea	Cyperaceae	Panichaise	H,A
Eleusina indica	Gramineae	Gaicha,Chapre	H,A
Heliotropium indicum	Boraginaceae	Hatisur	H,A
Leucas lavendulifolia	Labiatae	Dron	H,A
Lindernia crustacea	Scrophulariaceae	Bhui	H,A
Paspalum conjugatum	Gramineae	Dadkuri	H,Pe

Table G1: Checklist of Plants with Local Names, Family and Habit (Cont'd)

Scientific Name	Family	Local Name	Habit
Rottboellia protensa	Gramineae	Barajati	H,Pe
Rorippa indica	Cruciferae	Bansarisha	H,Pe
Solanum filicifolium	Solanaceae	Titbegun	S,Pe
Solanum nigrum	Solanaceae	Kakmachi	H,A
Spilanthes acmella	Compositae	Marhatitiga	H,A
Homestead			
Calamus tenuis	Palmae	Jalibet	Cl,Pe

H: Herb; S: Shrub; Cl: Climber; A: Annual; Pe: Perennial.

Table G2: Use of Different Wetland Plant Species

Species	Uses
Submerged	
Aponogeton natans	FS,FV
Aponogeton undulatus	FS,M,FV
Aponogeton appendiculatus	FS,M,FV
Blyxa sp.	--
Ceratophyllum desmersum	FP,FU
Hydrilla verticillata	M,FP,BF
Lagarosiphon roxburghii	BF
Myriophyllum tuberculatum	M,FP
Myriophyllum tetrandrum	M,FP
Najas sp.	--
Ottelia alismoides	FS,FV,FP
Potamogeton crispus	M,FP
Potamogeton mucronatus	M,FP
Rotala rutundifolia	--
Sagittaria guayanensis spp.*lappula*	M
Sagittaria sagittifolia	M
Vallisnaria spiralis	OR,BF
Free Floating	
Azolla pinnata	BF
Eichhornia crassipes	FP,BF,OR,BG
Lemna perpusilla	BF
Pistia stratiotes	BF,BG
Salvinia cucullata	BF
Salvinia natans	BF
Spirodela punctata	--
Spirodela polyrhiza	--
Utricularia exoleata	M
Utricularia aurea	M
Utricularia stellaris	M

Table G2: Use of Different Wetland Plant Species (Cont'd)

Species	Uses
Wolffia arrhiza	BF
Wolffia microscopica	BF
Rooted Floating	
Echinochloa colonum	FS,FP,FU
Hygroryza aristata	FS,FP
Limnophila indica	M,FP,OR
Limnophila sessiliflora	M,FP
Limnophila heterophylla	M,FP
Mersilea quadrifoliata	M,FV
Nymphaea stellata	FS,M,FV,FP,OR,BG
Nymphaea nouchali	FS,M,FV,FP,OR,BG
Nymphoides cristatum	M,FP,OR
Nymphoides indicum	M,FP,OR
Panicum paludosum	FP,FU
Pseudoraphis spinescens	FP
Pseudoraphis brunoninan	FP
Trapa maximowiczii	FS,FF,FP
Sedges & Meadows	
Aeschynomene aspera	OR,BF,FU
Aeschynomene indica	OR,FU
Alternanthera philoxeroides	FV,FP
Arundo donax	FB,FP
Cleome hasslerana	OR,M
Clinogyne dichotoma	FB
Colocasia esculenta	FV,M
Cyperus sp.	FP,FB
Eclipta alba	M
Eleocharis dulcis	FP
Enhydra fluctuans	FV,M
Fimbristylis dichotoma	--
Fimbristylis miliacea	--

Table G2: Use of Different Wetland Plant Species (Cont'd)

Species	Uses
Fimbristylis squarrosa	--
Hemarthria protensa	FB,FP
Ipomoea aquatica	FV,FP
Ipomoea fistulosa	FU,OR,OT
Ludwigia abscendens	FP,OR
Ludwigia repens	--
Monochoria hastata	M,OT
Oryza rufipogon	FS,FP
Polygonum glabrum	M
Polygonum stagninum	M
Polygonum lanatum	M
Polygonum pedunculare	M
Polygonum barbatum	M
Rumex maritimus	M
Setaria glauca	FP
Setaria fusca	FP
Schoenoplectus articulatus	FP,FB
Scirpus juncoides	FP
Sclerostachya fusca	FB,FP
Sesbania roxburghii	FU,BF
Vetiveria zizanioides	FB,FU
Xanthium indicum	FV,M
Reeds	
Asclepias sp.	M
Asparagus racemosus	M
Ficus heterophylla var. *heterophylla*	FU
Lippia javanica	FU,M
Phragmites karka	FB,TS,OT
Rosa involucrata	FU,OT
Saccharum spontaneum	FB,FU,TS,OT
Crop Field	

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Table G2: Use of Different Wetland Plant Species (Cont'd)

Species	Uses
Alternanthera sessilis	FV,FP
Amaranthus spinosus	FV,M
Chenopodium ambrosoides	FV,FP
Cotula hemispherica	--
Croton bonplandianum	M
Cynodon dactylon	FP,OR
Cyperus cephalotes	FB
Centipeda orbicularis	M
Dentella repens	--
Digitaria longiflora	FP
Eleocharis atropurpurea	FP
Eleusina indica	FP
Heliotropium indicum	M
Leucas lavendulifolia	M
Lindernia crustacea	--
Paspalum conjugatum	FP
Rottboellia protensa	--
Rorippa indica	--
Solanum khasianum	M,FV
Solanum filicifolium	M
Solanum nigrum	M
Spilanthes acmella	M
Homestead	
Calamus tenuis	FB

Uses :
M- medicinal/narcotic/poison; C- ceremonial; FF- food: fruit & nuts;
FS- food:starch/sugar/cereals; FV- food: vegetable; B- beverages;
VO- vegetable oils; SF- spices/flavours; EO- essential oils; FU- fuel;
SM- smoking/chewing; FP- feed plants/forage; DT- dyes; OR- ornament/hedge;
TS- timber/structures; EX- exudates/resins; FB- fiber/thatching/wickerwork;
FT- katha fishing entrenchment; BF- bio-fertilizer; BG-bio gas; OT- other uses.

LIST OF FISH SPECIES
RECORDED INSIDE SHANIR HAOR FCD PROJECT

Total of 88 species (85 indigenous, 3 exotic introductions)

SYNGNATHIDAE, Pipefishes
- Microphis deocata KUMIRER KHIL
- Doryichthys cuncalus KUMIRER KHIL

ANGUILLIDAE, Freshwater eels
- Anguilla bengalensis BAMOSH

SYNBRANCHIDAE, Mud eels
- Monopterus cuchia KUCHIA

TETRAODONTIDAE, Puffers
- Tetraodon cutcutia POTKA

BELONIDAE, Needlefishes
- Xenentodon cancila KAIKKA

HEMIRHAMPHIDAE, Halfbeaks
- Hyporhamphus gaimardi EK THUITA

CYPRINODONTIDAE, Killifishes
- Aplocheilus panchax KANPONA

CHANNIDAE, Snakeheads
- Channa striatus SHOL
- Channa marulius GAJAR
- Channa punctatus TAKI, LATI
- Channa orientalis GACHUA, CHENG

CYPRINIDAE, Carps, minnows, rasboras, barbs, suckers

LEUSCISCINAE, Minnows
- Oxygaster gora GHORA CHELA
- Salmostoma argentea CHELA
- Salmostoma phulo FULCHELA

RASBORINAE, Rasboras
- Esomus danricus DARKINA
- Chela laubuca KASH KHAIRA
- Rasbora elanga ALONG
- Rasbora rasbora LEUZZA DARKINA
- Rasbora daniconius DARKINA
- Barilius bendelisis JOIA, HIRALU, TILA, CHEDRA, KOKSA
- Danio devario BANSPATA, CHEBLI

CYPRININAE, Carps and barbs
- Amblypharyngodon mola MOLA
- Amblypharyngodon microlepis MOLA
- Rohtee cotio CHELA
- Labeo gonius GHONIA
- Labeo calbasu KALIBAUS, KALBASU
- Labeo rohita RUI
- Labeo bata BATA
- Cirrhinus mrigala MRIGEL
- Cirrhinus reba LASU, LACHO

LIST OF FISH SPECIES
RECORDED INSIDE SHANIR HAOR FCD PROJECT (Cont'd)

Puntius sarana SARPUNTI
Puntius chola CHALA PUNTI
Puntius ticto TIT PUNTI
Puntius gelius GILI PUNTI
Puntius sophore JAT PUNTI
Tor tor MOHASOL
Catla catla CATLA, KATAL
COBITIDAE, Loaches
Nemachilus botia BALICHATA
Somileptes gongota PAHARI GUTUM
Botia dario RANI
Lepidocephalus guntea GUTUM
CLARIIDAE, Walking catfishes
Clarias batrachus MAGUR
SILURIDAE, Butter catfishes, Freshwater shark
Wallago attu BOAL
Ompok bimaculatus KANI PABDA
Ompok pabda MADHU PABDA
HETEROPNEUSTIDAE, Stinging catfishes
Heteropneustes fossilis SINGI
CHACIDAE, Catfishes
Chaca chaca CHEKA
SCHILBEIDAE, Catfishes
Ailia coila KAJULI
Ailiichthys punctata BASPATA, ANULI
Pseudeutropius atherinoides BATASI
Eutropiichthys vacha BACHA
Clupisoma garua GHAURA, LAURA
BAGRIDAE, Catfishes
Chandramara chandramara
Batasio tengana TENGRA
Aorichthys aor AIR, GHAGOT
Aorichthys seenghala GUIZZA
Mystus cavasius GULSHA
Mystus bleekeri TENGRA
Mystus tengara BAJARI TENGRA
Mystus vittatus TENGRA
Mystus armatus
NOTOPTERIDAE, Knifefishes
Notopterus chitala CHITAL
Notopterus notopterus FOLI, KANGLA
ENGRAULIDAE, Anchovies
Setipinna phasa PHASA

LIST OF FISH SPECIES
RECORDED INSIDE SHANIR HAOR FCD PROJECT (Cont'd)

CLUPEIDAE, Shads, herrings, sradines
- Gudusia chapra CHAPILA
- Hilsa ilisha HILSA, ILISH
- Corica soborna KACHKI

MASTACEMBELIDAE, Spiny eels
- Macrognathus aculeatus TARA BAIM
- Mastacembelus armatus BAIM
- Mastacembelus pancalus CHIRKA BAIM

MUGILIDAE, Mullets
- Rhinomugil corsula KHORSULA

ANABANTIDAE, Climbing perches, gouramies
- Colisa sota BOICHA
- Colisa fasciatus KHAILSHA
- Ctenops nobilis NAFTINI
- Anabas testudineus KOI

GOBIIDAE, Gobies
- Brachygobius nunus NUNA BAILLA
- Glossogobius giuris BAILLA, BELE

NANDIDAE, Mud perches, leaffishes
- Nandus nandus MENI, BHEDA
- Badis badis NAPIT

AMBASSIDAE, Glassfishes
- Chanda nama CHANDA
- Chanda ranga LAL CHANDA
- Chanda sp indet

PRAWNS
- Macrobrachium rosenbergi, GOLDA CHINGRI, BORO ITCHA
- Small prawns ITCHA, CHINGRI

<u>EXOTIC INTRODUCTIONS</u>
- Hypophthalmichthys molitrix SILVER CARP
- Cyprinus carpio COMMON CARP, CARPIO
- Ctenopharyngodon idellus GRASS CARP

Table G3: List of Amphibians, Reptiles and Mammals

Scientific Name	English Name	Status	Habit	Description
AMPHIBIA				
Bufo melanostictus	Common Toad	VC	WL,FS	W
Rana cyanophlyctis	Skipper Frog	VC	WL	W
Rana tigrina	Bull Frog	C	WL	W
Rana limnocharis	Cricket Frog	C	WL	W
REPTILIA				
CHELONIA				
Hardella thurjii	Brahminy Turtle	S	WL	W
Kachuga tecta	Common Roof Turtle	UC	WL	W
Geoclemys hamiltoni	Spotted Pond Turtle	R,T	WL,RR	W
Lissemys punctata	Spotted Flapshell	C	WL	W
Aspideretes hurum	Peacock Softshell	C	WL,RR	W
LACERTILIA				
Hemidactylus brooki	House Lizard	C	HS	W
Hemidactylus frenatus	Common Lizard	VC	HS	W
Gekko gecko	Wall Lizard	UC	HS,FS	W
Calotes versicolor	Garden Lizard	UC	HS	W
Mabuya carinata	Common Skink	C	HS,FS	W
Varanus bengalensis	Bengal Lizard	UC	HS,FS,WL	W
OPHIDIA				
Lycodon jara	Yellow Wolf Snake	UC	HS,WL	W
Amphiesma stolata	Striped Keelback	C	HS,WL	W
Xenochrophis piscator	Checkered Keelback	VC	HS,WL	W
Xenochrophis	Dark-bellied			
cerasogaster	Marsh Snake	UC	WL,FS	W
Atretium schistosum	Olive Keelback	C	WL	W
Ptyas mucosus	Rat Snake	UC	HS	W
Enhydris enhydris	Smooth Water Snake	VC	WL	W
Bungarus fasciatus	Banded Krait	S	HS	W
Naja naja kaouthia	Monocellate Cobra	UC	HS,WL	W

Table G3: List of Amphibians, Reptiles and Mammals (Cont'd)

Scientific Name	English Name	Status	Habit	Description
MAMMALIA				
Suncus murinus	Grey Musk Shrew	VC	WL,HS	W
Pteropus giganteus	Flying Fox	VC	HS	W
Cynopterus spinx	Short-nosed Fruit Bat	C	HS	W
Megaderma lyra	False Vampire	UC	HS,FS	W
Pipistrellus coromandra	Indian Pipistrelle	VC	HS,FS	W
Hesperoptenus tickelli	Tickell's Bat	VC	HS,FS	W
Canis aureus	Jackal	UC	HS	W
Lutra lutra	Common Otter	R	WL,FS,RR	W
Viverra zibetha	Large Indian Civet	UC	HS	W
Herpestes auropunctatus	Small Indian Mongoose	VC	HS	W
Felis viverrina	Fishing Cat	UC	HS,FS,WL	W
Felis chaus	Jungle Cat	Formerly present, present occurence uncertain		
Bandicota bengalensis	Mole Rat	C	HS,FS	W
Bandicota indica	Bandicot Rat	C	HS,FS	W
Mus booduga	Field Mouse	C	HS	W
Mus musculus	House Mouse	C	HS	W
Rattus rattus	Common House Rat	C	HS	W
Platanista gangetica	Ganges Freshwater Dolphin	C	RR	W

LEGEND : VC - Very Common; C - Common; UC - Uncommon; S - Scarce; R - Rare; T - Threatened; E -Endangered; K - Indeterminate/unknown; WL - Wetland; FS - Freshwater Swamp; RR - Large Rivers; HS - Homestead forests and land adjacent to wetlands; W - Widely distributed; RS - Restricted distribution; ? - Unknown; Extinct - Extinct from the whole country.

CHECKLIST OF BIRDS RECORDED IN SHANIR HAOR

The sequence and nomenclature follow Harvey, W.G. (1990) Birds in Bangladesh, University Press, Dhaka.

PODICIPEDIDAE
- Little Grebe *Tachybaptus ruficollis*
- Great Crested Grebe *Podiceps cristatus*

PHALACROCORACIDAE
- Great Cormorant *Phalacrocorax carbo*
- Little Cormorant *P. niger*
- Oriental Darter *Anhinga melanogaster*

ARDEIDAE
- Yellow Bittern *Ixobrychus sinensis*
- Cinnamon Bittern *I. cinnamomeus*
- Black-crowned Night-Heron *Nycticorax nycticorax*
- Little Heron *Butorides striatus*
- Indian Pond Heron *Ardeola grayii*
- Cattle Egret *Bubulcus ibis*
- Little Egret *Egretta garzetta*
- Intermediate Egret *E. intermedia*
- Great Egret *E. alba*
- Grey Heron *Ardea cinerea*
- Purple Heron *A. purpurea*

CICONIIDAE
- Asian Openbill *Anastomus oscitans*
- Lesser Adjutant *Leptoptilos javanicus*

THRESKIORNITHIDAE
- Black-headed Ibis *Threskiornis melanocephala*
- White Spoonbill *Platalea leucorodia*

ANATIDAE
- Fulvous Whistling Duck *Dendrocygna bicolor*
- Lesser Whistling Duck *D. javanica*
- Greylag Goose *Anser anser*
- Ruddy Shelduck *Tadorna ferruginea*
- Common Shelduck *T. tadorna*
- Cotton Pygmy Goose *Nettapus coromandelianus*
- Eurasian Wigeon *Anas penelope*
- Falcated Teal *A. falcata*
- Gadwall *A. strepera*
- Common Teal *A. crecca*
- Mallard *A. platyrhynchos*
- Spot-billed Duck *A. poecilorhyncha*
- Northern Pintail *A. acuta*
- Garganey *A. querquedula*
- Northern Shoveler *A. clypeata*
- Red-crested Pochard *Netta rufina*
- Common Pochard *Aythya ferina*
- Baer's Pochard *A. baeri*

CHECKLIST OF BIRDS RECORDED IN SHANIR HAOR (Cont'd)

Ferruginous Duck *A. nyroca*
Tufted Duck *A. fuligula*
Greater Scaup *A. marila*

ACCIPITRIDAE
Crested Honey-Buzzard *Pernis ptilorhynchus*
Black-shouldered Kite *Elanus caeruleus*
Black/Pariah Kite *Milvus migrans*
Brahminy Kite *Haliastur indus*
Pallas's Fish-Eagle *Halieetus leucoryphus*
Grey-headed Fish-Eagle *Ichthyophaga ichthyaetus*
White-rumped Vulture *G. bengalensis*
Long-billed Vulture *G. indicus*
Crested Serpent-Eagle *Spilornis cheela*
Western Marsh Harrier *Circus aeruginosus*
Eastern Marsh Harrier *C. spilonotus*
Pied Harrier *C. melanoleucos*
Shikra *A. badius*
Steppe Eagle *A. nipalensis*
Changeable Hawk-Eagle *Spizaetus cirrhatus*
Osprey *Pandion haliaetus*

FALCONIDAE
Eurasian Kestrel *Falco tinnunculus*
Northern Hobby *F. subbuteo*

RALLIDAE
Slaty-breasted Rail *Gallirallus striatus*
Common Moorhen *Gallinula chloropus*
Purple Swamphen *Porphyrio porphyrio*
Watercock *Gallicrex cinerea*
Eurasian Coot *Fulica atra*

JACANIDAE
Pheasant-tailed Jacana *Hydrophasianus chirurgus*
Bronze-winged Jacana *Metopidius indicus*

ROSTRATULIDAE
Greater Paintedsnipe *Rostratula benghalensis*

RECURVIROSTRIDAE
Black-winged Stilt *Himantopus himantopus*
Pied Avocet *Recurvirostra avosetta*

GLAREOLIDAE
Oriental Pratincole *Glareola maldivarum*
Small Pratincole *G. lactea*

CHARADRIIDAE
Little Ringed Plover *Charadrius dubius*
Kentish Plover *C. alexandrinus*
Mongolian Plover *C. mongolus*
Asiatic Golden Plover *Pluvialis fulva*
Grey Plover *P. squatarola*

CHECKLIST OF BIRDS RECORDED IN SHANIR HAOR (Cont'd)

Grey-headed Lapwing *Vanellus cinereus*
Red-wattled Lapwing *V. indicus*
Little Stint *Calidris minuta*
Temminck's Stint *C. temminckii*
Long-toed Stint *C. subminuta*
Dunlin *C. alpina*
Curlew Sandpiper *C. ferruginea*
Broad-billed Sandpiper *Limicola falcinellus*
Ruff *Philomachus pugnax*
Common Snipe *Gallinago gallinago*
Pintail Snipe *G. stenura*
Black-tailed Godwit *Limosa limosa*
Eurasian Curlew *Numenius arquata*
Spotted Redshank *Tringa erythropus*
Common Redshank *T. totanus*
Marsh Sandpiper *T. stagnatilis*
Common Greenshank *T. nebularia*
Green Sandpiper *T. ochropus*
Wood Sandpiper *T. glareola*
Common Sandpiper *Actitis hypoleucos*

LARIDAE

Common Black-headed Gull *Larus ridibundus*
Brown-headed Gull *L. brunnicephalus*
River Tern *Sterna aurantia*
Common Tern *S. hirundo*
Little Tern *S. albifrons*
Whiskered Tern *Childonias hybrida*

COLUMBIDAE

Rock Dove *Columba livia*
Collared Dove *Streptopelia decaocto*
Red Turtle Dove *S. tranquebarica*
Oriental Turtle Dove *S. orientalis*
Spotted Dove *S. chinensis*
Yellow-footed Pigeon *T. phoenicoptera*

PSITTACIDAE

Rose-ringed Parakeet *Psittacula krameri*
Red-breasted Parakeet *P. alexandri*

CUCULIDAE

Common Hawk-Cuckoo *Cuculus varius*
Indian Cuckoo *C. micropterus*
Plaintive Cuckoo *C. merulinus*
Common Koel *Eudynamys scolopacea*
Lesser Coucal *C. bengalensis*

STRIGIDAE

Brown Fish-Owl *Ketupa zeylonensis*
Spotted Owlet *Athene brama*

CHECKLIST OF BIRDS RECORDED IN SHANIR HAOR (Cont'd)

CAPRIMULGIDAE
- Large-tailed Nightjar *Caprimulgus macrurus*

APODIDAE
- House Swift *Apus affinis*
- Asian Palm-Swift *Cypsiurus balasiensis*

ALCEDINIDAE
- White-throated Kingfisher *Halcyon smyrnensis*
- Common Kingfisher *Alcedo atthis*
- Pied Kingfisher *Ceryle rudis*

MEROPIDAE
- Green Bee-eater *Merops orientalis*
- Chestnut-headed Bee-eater *M. leschenaulti*

CORACIIDAE
- Indian Roller *Coracias benghalensis*

UPUPIDAE
- Hoopoe *Upupa epops*

CAPITONIDAE
- Lineated Barbet *Megalaima lineata*
- Blue-throated Barbet *M. asiatica*
- Coppersmith Barbet *M. haemacephala*

PICIDAE
- Speckled Piculet *Picumnus innominatus*
- Black-rumped Flameback *Dinopium benghalense*
- Fulvous-breasted Woodpecker *Picoides macei*

ALAUDIDAE
- Rufous-winged Bushlark *Mirafra assamica*
- Short-toed Lark *Calandrella sp*
- Oriental Skylark *Alauda gulgula*

HIRUNDINIDAE
- Plain Martin *Riparia paludicola*
- Sand Martin *R. riparia*
- Barn Swallow *Hirundo rustica*
- Red-rumped Swallow *H. daurica*

MOTACILLIDAE
- Paddyfield/Richard's Pipit *Anthus rufulus/richardi*
- Olive Tree Pipit *A. hodgsoni*
- Yellow Wagtail *Motacilla flava*
- Yellow-hooded Wagtail *M. citreola*
- Grey Wagtail *M. cinerea*
- White Wagtail *M. alba*

CAMPEPHAGIDAE
- Large Wood-shrike *Tephrodornis virgatus*
- Black-faced Cuckoo-shrike *Coracina novaehollandiae*
- Black-winged Cuckoo-shrike *C. melaschistos*
- Scarlet Minivet *Pericrocotus flammeus*

PYCNONOTIDAE
- Red-whiskered Bulbul *P. jocosus*
- Red-vented Bulbul *P. cafer*

IRENIDAE
- Common Iora *Aegithina tiphia*
- Gold-fronted Leafbird *Chloropsis aurifrons*

MUSCICAPIDAE
- Bluethroat *Erithacus svecicus*
- Magpie Robin *Copsychus saularis*
- Black Redstart *Phoenicurus ochruros*
- Stonechat *Saxicola torquata*
- Zitting Cisticola *Cisticola juncidis*
- Rufescent Prinia *Prinia rufescens*
- Common Tailorbird *Orthotomus sutorius*
- Pallas's Warbler *Locustella certhiola*
- Lanceolated Warbler *L. lanceolata*
- Striated Warbler *Megalurus palustris*
- Thick-billed Warbler *Acrocephalus aedon*
- Blunt-winged/Paddyfield Warbler *A. concinens/agricola*
- Blyth's Reed Warbler *A. dumetorum*
- Black-browed Reed Warbler *A. bistrigiceps*
- Clamorous Reed Warbler *A. stentoreus*
- Blyth's Leaf Warbler *Phylloscopus reguloides*
- Greenish Warbler *P. trochiloides*
- Dusky Warbler *P. fuscatus*
- Dark-sided Flycatcher *M. sibirica*
- Red-throated Flycatcher *Ficedula parva*
- White-throated Fantail *Rhipidura albicollis*
- Black-naped Monarch *Hypothymis azurea*
- Grey-headed Flycatcher *Culicicapa ceylonensis*

PARIDAE
- Great Tit *Parus major*

NECTARINIIDAE
- Purple Sunbird *N. asiatica*
- Little Spiderhunter *Arachnothera longirostris*
- Scarlet-backed Flowerpecker *D. cruentatum*

ZOSTEROPIDAE
- Oriental White-eye *Zosterops palpebrosa*

ORIOLIDAE
- Black-hooded Oriole *Oriolus xanthomus*

LANIIDAE
- Brown Shrike *Lanius cristatus*
- Long-tailed Shrike *L. schach*

DICRURIDAE
- Black Drongo *Dicrurus macrocercus*
- Bronzed Drongo *D. aeneus*

CHECKLIST OF BIRDS RECORDED IN SHANIR HAOR (Cont'd)

Lesser Racket-tailed Drongo *D. remifer*

ARTAMIDAE

Ashy Wood-Swallow *Artamus fuscus*

CORVIDAE

Rufous Treepie *Dendrocitta vagabunda*
House Crow *Corvus splendens*
Large-billed Crow *C. macrorynchos*

STURNIDAE

Chestnut-tailed Starling *Sturnus malabaricus*
Asian Pied Starling *S. contra*
Common Myna *Acridotheres tristis*
Jungle Myna *A. fuscus*
Hill Myna *Gracula religiosa*

PLOCEIDAE

House Sparrow *Passer domesticus*
Eurasian Tree Sparrow *P. montanus*
Black-breasted Weaver *Ploceus benghalensis*
Streaked Weaver *P. manyar*
Baya Weaver *P. philippinus*
White-rumped Munia *Lonchura striata*
Scaly-breasted Munia *L. punctulata*
Chestnut Munia *L. malacca*

FRINGILIDAE

Black-faced Bunting *Emberiza spodocephala*
Chestnut-eared Bunting *E. fucata*
Yellow-breasted Bunting *E. aureola*

APPENDIX H

ECONOMIC EVALUATION DATA

APPENDIX H : ECONOMIC EVALUATION DATA

INDEX

YEAR 1: CROP MARKET PRICES

OUTPUTS

Crops		Main Product Market	By–Product Market	ByProd Fctr
B Aman	Tk/T	6438	950	1.0
LT Aman	Tk/T	6438	950	2.0
L Boro	Tk/T	6212	950	2.0
HYV Boro	Tk/T	6212	700	1.0
Wheat	Tk/T	6312	600	1.0
Potato	Tk/T	4580		
Jute	Tk/T	8012	2550	2.0
Oilseeds	Tk/T	13466		
Spices	Tk/T	9047		
Veg	Tk/T	1389		

INPUTS

FERTILIZER		Market
Urea	Tk/kg	7.50
TSP	Tk/kg	8.50
MP	Tk/kg	6.50
SEEDS		
B Aman	Tk/kg	10.00
LT Aman	Tk/kg	10.00
L Boro	Tk/kg	10.00
HYV Boro	Tk/kg	10.00
Wheat	Tk/kg	12.00
Potato	Tk/kg	8.50
Jute	Tk/kg	24.00
Oilseeds	Tk/kg	19.00
Spices	Tk/kg	600
Veg	Tk/kg	400
OTHERS		
Pesticide	Tk/kg	504.00
Labour	Tk/md	50.00
D.Animal	Tk/bd	45.00
Irri–trad	Tk/ha	1000
Irri–LLP	Tk/ha	2000

YEAR 1: AVERAGE CROP YIELDS PER HECTARE

Tons per ha

Crops	Main Product
B Aman	1.5
LT Aman	1.8
L Boro	2.0
HYV Boro	3.9
Wheat	1.6
Potato	10.5
Jute	1.7
Oilseeds	0.6
Spices	2.3
Veg	7.0

YEAR 1: TOTAL PRODUCTION

Tons

TOTAL PRODUCTION – tonnes

Crop	Main Product	By–product
B Aman	191	191
LT Aman	172	344
L Boro	9874	19747
HYV Boro	987	987
Wheat	92	92
Potato	214	
Jute	34	67
Oilseeds	46	
Spices	46	
Veg	143	
Total Prod'n	11797	21428

YEAR 1: CROP AREAS

(data input)

NET AREAS –ha:	6700
CROPPED: (calc)	5537.55
INTENSITY:(calc)	0.8

CROP AREAS –ha:

Crops	Damage Free Area: 1992–93	Damaged Area: 1992–93
B Aman	127.3	
LT Aman	95.475	
L Boro	4692.278	145.35
HYV Boro	246.722	7.65
Wheat	57.285	
Potato	20.368	
Jute	20.368	
Oilseeds	84.018	
Spices	20.368	
Veg	20.368	
Total Crop Area	5384.55	153

YEAR 1: CROP YIELDS IN DAMAGE-FREE AND DAMAGED AREAS

(data input)

Tons per ha

Crops	Damage Free Area: 1992–93	Damaged Area: 1992–93
B Aman	1.50	
LT Aman	1.80	
L Boro	2.05	1.75
HYV Boro	3.90	3.25
Wheat	1.60	
Potato	10.50	
Jute	1.65	
Oilseeds	0.55	
Spices	2.25	
Veg	7.00	

YEAR 1: INPUT REQUIREMENTS PER HECTARE

Crops	Seed Kg/ha	Urea Kg/ha	TSP Kg/ha	labour Md/ha	D.Animal Pair/ha	Irri-trad ha	Irri-LLP ha	Pesticide Kg/ha
B Aman	100.0				42.0			
LT Aman	30.0				42.0			0.3
L Boro	30.0			36.0	40.0	1		0.1
HYV Boro	30.0	55.0	42.5	73.0	52.0		1.0	0.5
Wheat	140.0	50.0	35.0	117.0	42.0	0.5		0.3
Potato	1200.0			222.0	50.0	0.5		0.5
Jute	9.0			210.0	48.0			0.5
Oilseeds	10.0				36.0			0.1
Spices	0.1	22.0	18.0		38.0	0.5		
Veg	0.1	30.0	25.0	188.0	53.0	0.5		0.3

GROSS MARGINS – Tk/ha

Crop	Gross Value	Input Costs	Net Value
B Aman	11082	2890	8192
LT Aman	15008	2316	12692
L Boro	16556	4960	11596
HYV Boro	26822	9316	17506
Wheat	11059	10719	341
Potato	48090	24302	23788
Jute	21635	13128	8507
Oilseeds	7406	1860	5546
Spices	20356	2588	17768
Veg	9723	12889	−3165

SHANIR HAOR FCD PROJECT : "1992 – 93"

TOTAL GROSS MARGINS BY CROP

Crop	Area (ha)	Gross (Tk 000)	Net (Tk 000)
B Aman	127	1411	1043
LT Aman	95	1433	1212
L Boro	4838	80094	56097
HYV Boro	254	6823	4453
Wheat	57	634	20
Potato	20	979	485
Jute	20	441	173
Oilseeds	84	622	466
Spices	20	415	362
Veg	20	198	−64
Totals	5537.55	93049	64245

YEAR 1: FISHERIES IMPACTS

Net Project Area	6700

GROSS VALUE:

	Yield	Price	Gross Margin	COP	Net value
	Kg/ha	Tk/kg	Tk/ha	Tk/ha	Tk/ha
Flood Plain Area	76.4	18.12	1384	92	1292
Beel Area	121.8	40	4872	1830	3042

NET VALUE:

	Area		Total cost		Net Value
	ha		Tk (000)		Tk (000)
Flood Plain Area	6677		614		8629
Beel Area	475		869		1445
TOTAL					10074

Gross Project Area – ha		7010
Net Project Area – ha		6700
Floodplain – ha		6675
Impacted Floodplain – %	100%	
Beel Area – ha		476
Impacted Beel Area – %	100%	

FINANCIAL VALUE OF WETLAND PRODUCTS:

WETLAND PRODUCTS:		Tot Prod Kg	Price (Tk/Kg)	Gross Margin Tk
Food Products:				
	Khai/Ghechu	1000	10	10000
	Kola Phal	200	10	2000
	Paura	185000	0.41	75000
	Shaluk	1000	12	12000
	Dheb	200	25	5000
	Shingra	1000	10	10000
	Murta			15000
Plant Products:				
	Chailla	37000	0.54	20000
	Chan (bundle)	44	45	2000
	Hijal	500	100	50000
	Koroch	800	100	80000
	Others (Fuel)			
	(120 days available for 3859 hhs:		@ T	9261600
	Bio Fertilizer			100000
Animals:				
	Frog			4000
	Turtles	500	50	25000
	Duck	5000	40	200000
	Otter	50	65	3250
	Pink Pearl			5000
	Lime			2000
	Duck feed			25000
Gross Value:				9881850

Cost of collection (Hired labour requirements):

	md/yr	Wage	Total Cost
Hijal	80	50	4000
Koroch	50	50	2500
Total Cost			6500

Net Value:	9875350
Gross Margin/ ha	1479.45

YEAR 2: CROP MARKET PRICES

OUTPUTS

Crops		Main Product Market	By–Product Market	ByProd Fctr
B Aman	Tk/T	6438	950	1.0
LT Aman	Tk/T	6438	950	2.0
L Boro	Tk/T	6212	950	2.0
HYV Boro	Tk/T	6212	700	1.0
Wheat	Tk/T	6312	600	1.0
Potato	Tk/T	4580		
Jute	Tk/T	8012	2550	2.0
Oilseeds	Tk/T	13466		
Spices	Tk/T	9047		
Veg	Tk/T	1389		

INPUTS

FERTILIZER		Market
Urea	Tk/kg	7.50
TSP	Tk/kg	8.50
MP	Tk/kg	6.50
SEEDS		
B Aman	Tk/kg	10.00
LT Aman	Tk/kg	10.00
L Boro	Tk/kg	10.00
HYV Boro	Tk/kg	10.00
Wheat	Tk/kg	12.00
Potato	Tk/kg	8.50
Jute	Tk/kg	24.00
Oilseeds	Tk/kg	19.00
Spices	Tk/kg	600
Veg	Tk/kg	400
OTHERS		
Pesticide	Tk/kg	504.00
Labour	Tk/md	50.00
D.Animal	Tk/bd	45.00
Irri–trad	Tk/ha	1000
Irri–LLP	Tk/ha	2000

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YEAR 2: AVERAGE CROP YIELDS PER HECTARE

Tons per ha

Crops	Main Product
B Aman	1.5
LT Aman	1.8
L Boro	1.8
HYV Boro	3.5
Wheat	1.6
Potato	10.5
Jute	1.7
Oilseeds	0.6
Spices	2.3
Veg	7.0

YEAR 2: TOTAL PRODUCTION

Tons

Crop	Main Product	By–product
B Aman	191	191
LT Aman	172	344
L Boro	9993	19987
HYV Boro	991	991
Wheat	92	92
Potato	214	
Jute	34	67
Oilseeds	46	
Spices	46	
Veg	143	
Total Prod'n	11921	21672

YEAR 2: CROP AREAS

(data input)

NET AREAS –ha:	6700
CROPPED: (calc)	6365
INTENSITY:(calc)	1.0

CROP AREAS –ha:

Crops	Damage Free Area: 1992–93	Damaged Area: 1992–93
B Aman	127.3	
LT Aman	95.475	
L Boro	5362.23	275
HYV Boro	282.223	
Wheat	57.285	
Potato	20.368	
Jute	20.368	
Oilseeds	84.018	
Spices	20.368	
Veg	20.368	
Total Crop Area	6090.003	275

YEAR 2: CROP YIELDS IN DAMAGE-FREE AND DAMAGED AREAS

(data input)

Tons per ha

Crops	Damage Free Area: 1992–93	Damaged Area: 1992–93
B Aman	1.50	
LT Aman	1.80	
L Boro	1.85	0.36
HYV Boro	3.51	
Wheat	1.60	
Potato	10.50	
Jute	1.65	
Oilseeds	0.55	
Spices	2.25	
Veg	7.00	

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YEAR 2: INPUT REQUIREMENTS PER HECTARE

Crops	Seed Kg/ha	Urea Kg/ha	TSP Kg/ha	labour Md/ha	D.Animal Pair/ha	Irri–trad ha	Irri–LLP ha	Pesticide Kg/ha
B Aman	100.0				42.0			
LT Aman	30.0				42.0			0.3
L Boro	30.0			36.0	40.0	1		0.1
HYV Boro	30.0	55.0	42.5	73.0	52.0		1.0	0.5
Wheat	140.0	50.0	35.0	117.0	42.0	0.5		0.3
Potato	1200.0			222.0	50.0	0.5		0.5
Jute	9.0			210.0	48.0			0.5
Oilseeds	10.0				36.0			0.1
Spices	0.1	22.0	18.0		38.0	0.5		
Veg	0.1	30.0	25.0	188.0	53.0	0.5		0.3

YEAR 2: GROSS MARGINS

GROSS MARGINS – Tk/ha

Crop	Gross Value	Input Costs	Net Value
B Aman	11082	2890	8192
LT Aman	15008	2316	12692
L Boro	14380	4960	9420
HYV Boro	24261	9316	14945
Wheat	11059	10719	341
Potato	48090	24302	23788
Jute	21635	13128	8507
Oilseeds	7406	1860	5546
Spices	20356	2588	17768
Veg	9723	12889	−3165

SHANIR HAOR fYear−2

TOTAL GROSS MARGINS BY CROP

Crop	Area (ha)	Gross (Tk 000)	Net (Tk 000)
B Aman	127	1411	1043
LT Aman	95	1433	1212
L Boro	5637	81066	53102
HYV Boro	282	6847	4218
Wheat	57	634	20
Potato	20	979	485
Jute	20	441	173
Oilseeds	84	622	466
Spices	20	415	362
Veg	20	198	−64
Totals	6365	94045	61016

Net Margin/ha: 9586

YEAR 2: FISHERIES IMPACTS

Net Project Area	6700

GROSS VALUE:

	Yield	Price	Gross Margin	COP	Net value
	Kg/ha	Tk/kg	Tk/ha	Tk/ha	Tk/ha
Flood Plain Area	88.3	22.98	2029	92	1937
Beel Area	164.6	39	6419	1830	4589

NET VALUE:

	Area	Total cost	Net Value
	ha	Tk (000)	Tk (000)
Flood Plain Area	6677	614	12934
Beel Area	475	869	2180
TOTAL			15114

YEAR 2: WETLAND IMPACTS

Gross Project Area – ha		7010
Net Project Area – ha		6700
Floodplain – ha		6675
Impacted Floodplain – %	100%	
Beel Area – ha		476
Impacted Beel Area – %	100%	

FINANCIAL VALUE OF WETLAND PRODUCTS:

WETLAND PRODUCTS:		Tot Prod Kg	Price (Tk/Kg)	Gross Margin Tk
Food Products:				
	Khai/Ghechu	800	10	8000
	Kola Phal	200	10	2000
	Paura	111000	0.41	45000
	Shaluk	1000	12	12000
	Dheb	200	25	5000
	Shingra	800	10	8000
	Murta			15000
Plant Products:				
	Chailla	22200	0.54	12000
	Chan (bundle)	44	45	2000
	Hijal	500	100	50000
	Koroch	800	100	80000
	Others (Fuel)			
	(120 days available for 3859 hhs:		@ T	9261600
	Bio Fertilizer			100000
Animals:				
	Frog			4000
	Turtles	500	50	25000
	Duck	5000	40	200000
	Otter	50	65	3250
	Pink Pearl			5000
	Lime			2000
	Duck feed			25000
Gross Value:				9839850

Cost of collection (Hired labour requirements):

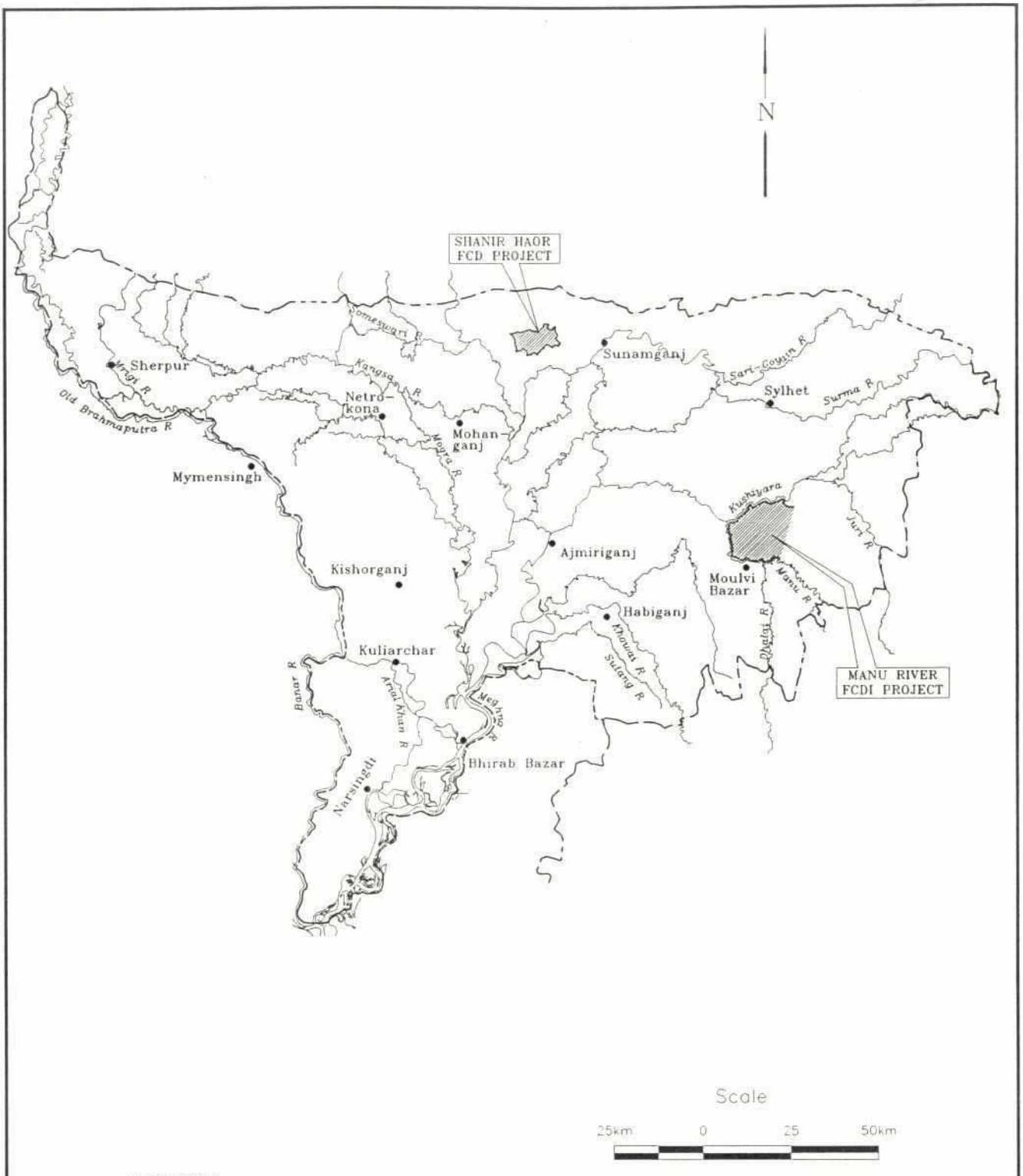
	md/yr	Wage	Total Cost
Hijal	80	50	4000
Koroch	50	50	2500
Total Cost			6500

Net Value:	9833350
Gross Margin/ ha	1473.16

APPENDIX I

FIGURES

Figure 1



Northeast Regional Project

Project Monitoring Programme Sites Shanir Haor & Manu River

Prepared by: BNP/Jalal	April 1993

XREF:FISH-121.DWG
FILE: FISH-110.DWG

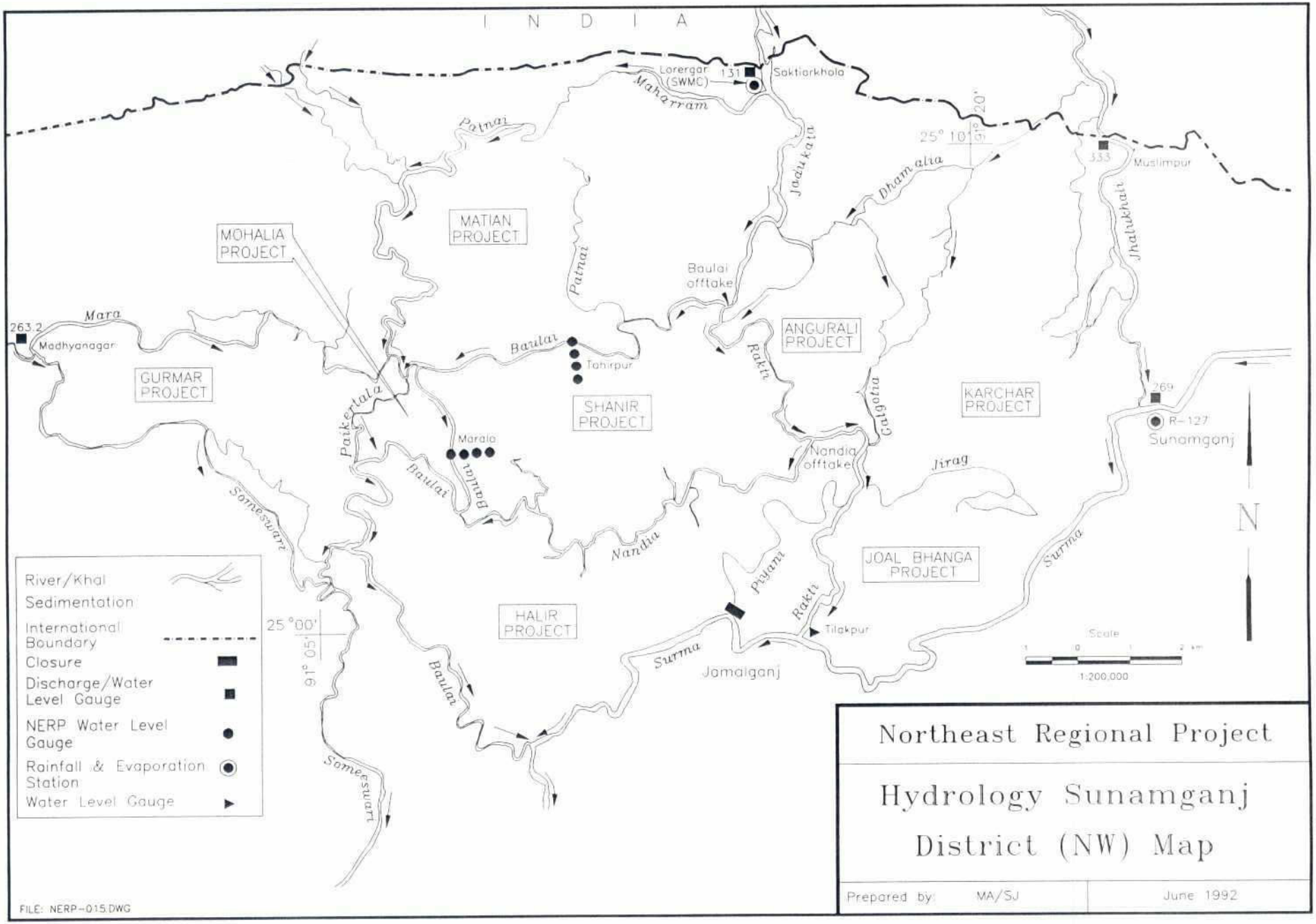

I N D I A
Lorergar (SWMC)
131
Saktiarkhola
Maharram
Patnai
Jadukata
Dhamalia
25° 10' 30"
333
Muslimpur
Jhalukhali
MATIAN PROJECT
MOHALIA PROJECT
Patnai
Baulai offtake
ANGURALI PROJECT
263.2
Mara
Madhyanagar
Baular
Tahirpur
Rakh
Gaigotia
KARCHAR PROJECT
269
R-127
Sunamganj
GURMAR PROJECT
Pakerdala
SHANIR PROJECT
Marala
Baular
Nandia offtake
Jirag
Somesuara
Nandia
Piyani
Rakh
JOAL BHANGA PROJECT
Surma
HALIR PROJECT
Tilakpur
Surma
Jamalganj
Baular
Somesuara
25°00'
91° 05'
River/Khal
Sedimentation
International Boundary
Closure
Discharge/Water Level Gauge
NERP Water Level Gauge
Rainfall & Evaporation Station
Water Level Gauge
N
Scale
1:200,000
Northeast Regional Project
Hydrology Sunamganj District (NW) Map
Prepared by: MA/SJ
June 1992
FILE: NERP-015.DWG

Figure 2

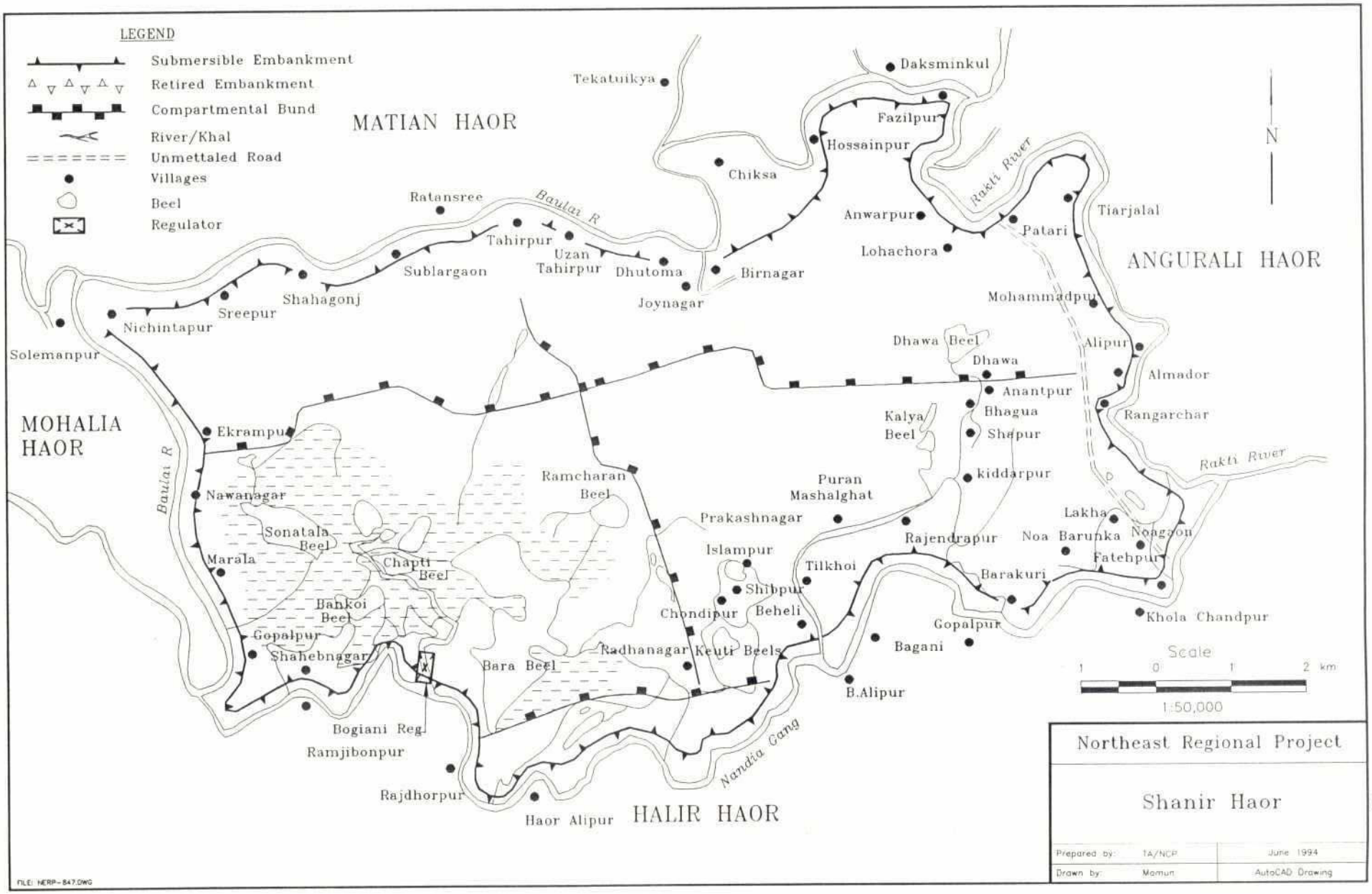
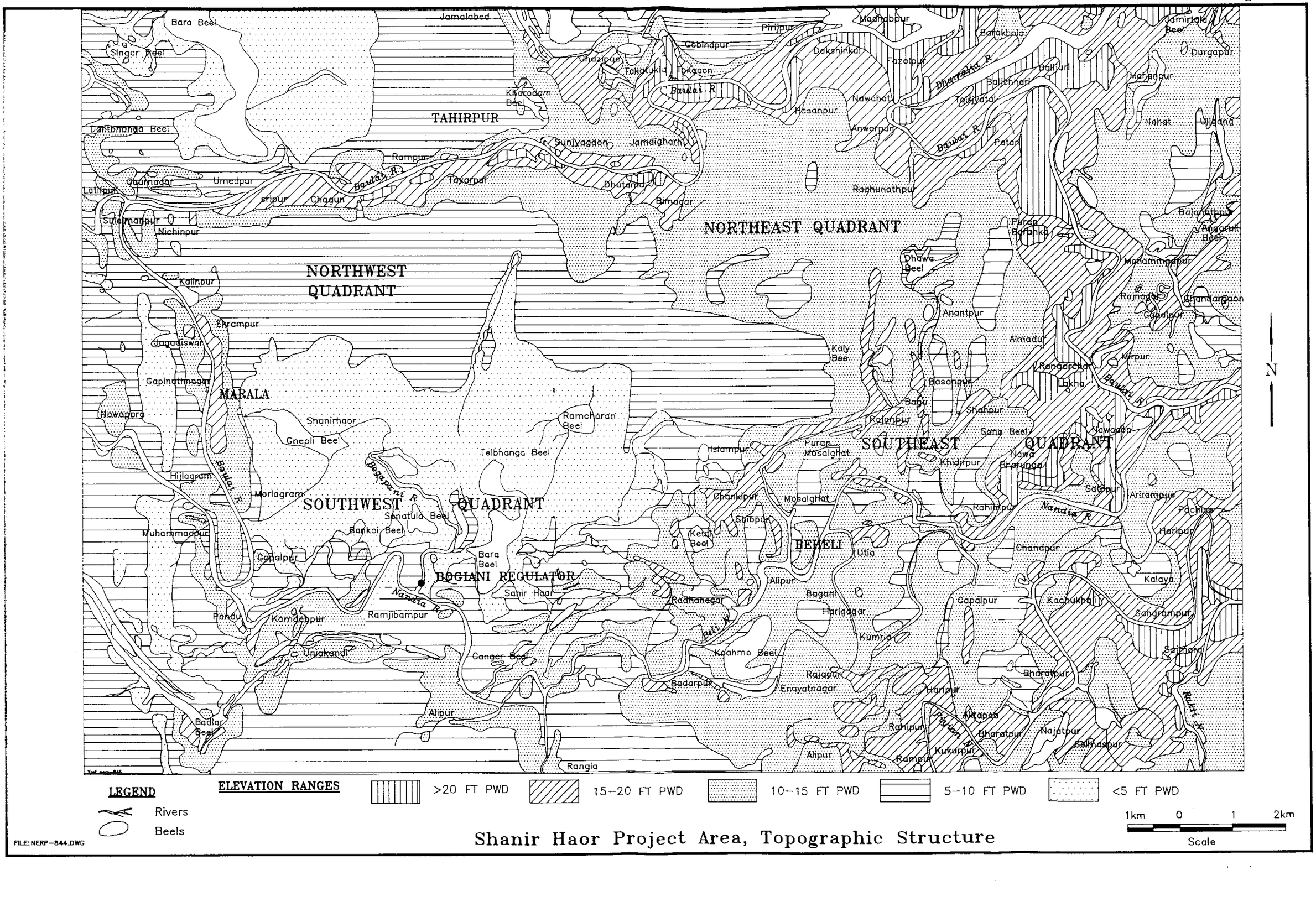

LEGEND
Submersible Embankment
Retired Embankment
Compartmental Bund
River/Khal
Unmettaled Road
Villages
Beel
Regulator
MATIAN HAOR
ANGURALI HAOR
MOHALIA HAOR
HALIR HAOR
Tekatuikya
Daksminkul
Fazilpur
Hossainpur
Chiksa
Ratansree
Baulai R
Tahirpur
Uzan Tahirpur
Dhutoma
Sublargaon
Birnagar
Joynagar
Anwarpur
Rakti River
Patari
Tiarjalal
Lohachora
Mohammadpur
Alipur
Almador
Rangarchar
Shahagonj
Sreepur
Nichintapur
Solemanpur
Dhawa Beel
Dhawa
Anantpur
Bhagua
Shapur
Kalya Beel
kiddarpur
Ekrampur
Nawanagar
Ramcharan Beel
Puran Mashalghat
Prakashnagar
Rajendrapur
Lakha
Noa Barunka
Noagaon
Fatehpur
Sonatala Beel
Marala
Chapti Beel
Islampur
Tilkhoi
Barakuri
Shibpur
Bankoi Beel
Chondipur
Beheli
Khola Chandpur
Gopalpur
Shahebnagar
Radhanagar
Keuti Beels
Bara Beel
Bagani
Gopalpur
B.Alipur
Bogiani Reg
Ramjibonpur
Rajdhorpur
Haor Alipur
Nandia Gang
N
Scale
1 0 1 2 km
1:50,000
Northeast Regional Project
Shanir Haor
Prepared by: TA/NCP
June 1994
Drawn by: Mamun
AutoCAD Drawing
FILE: NERP-847.DWG

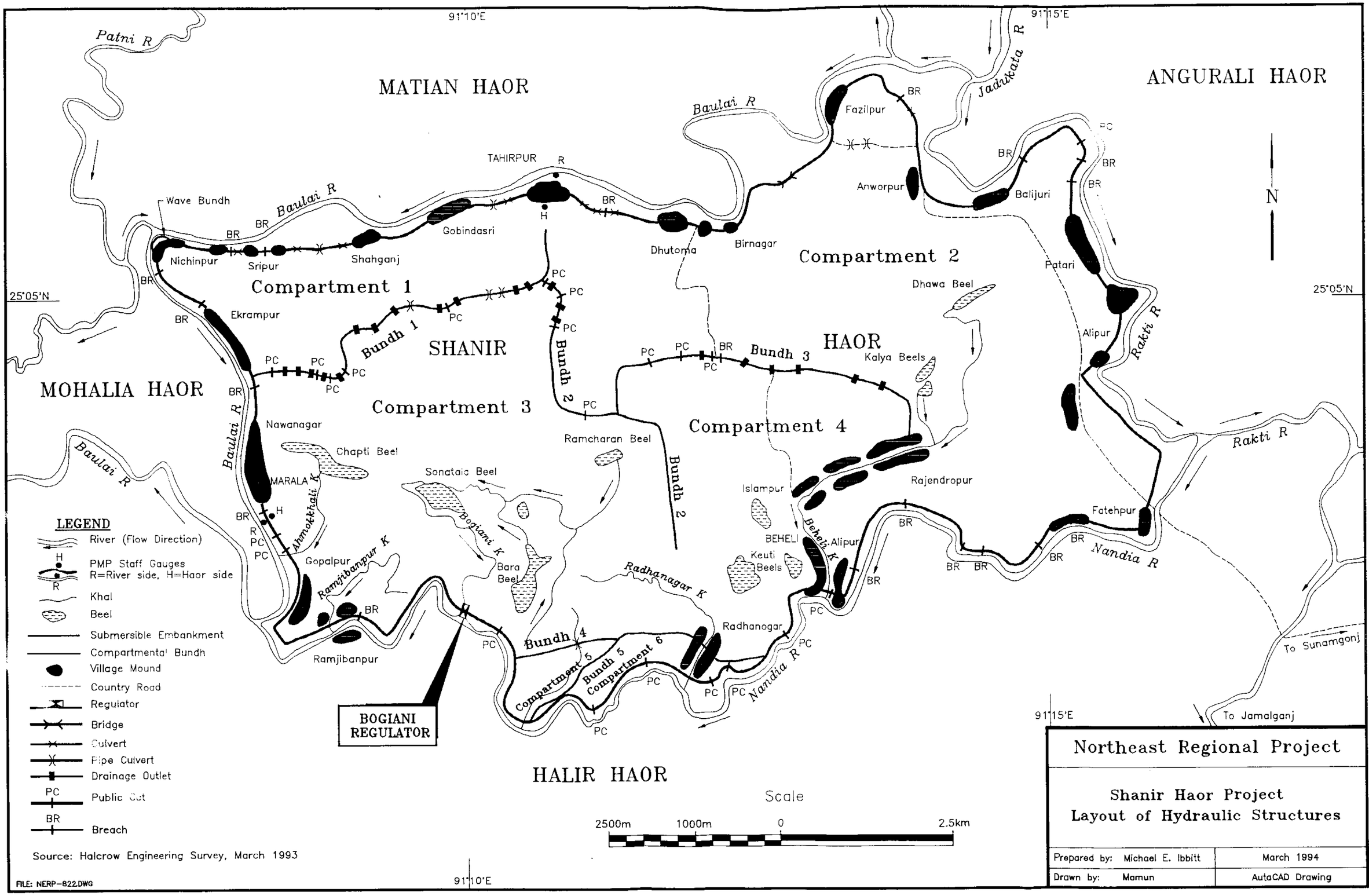
Figure 3

Figure 4



Shanir Haor Project Area, Topographic Structure

Figure 5

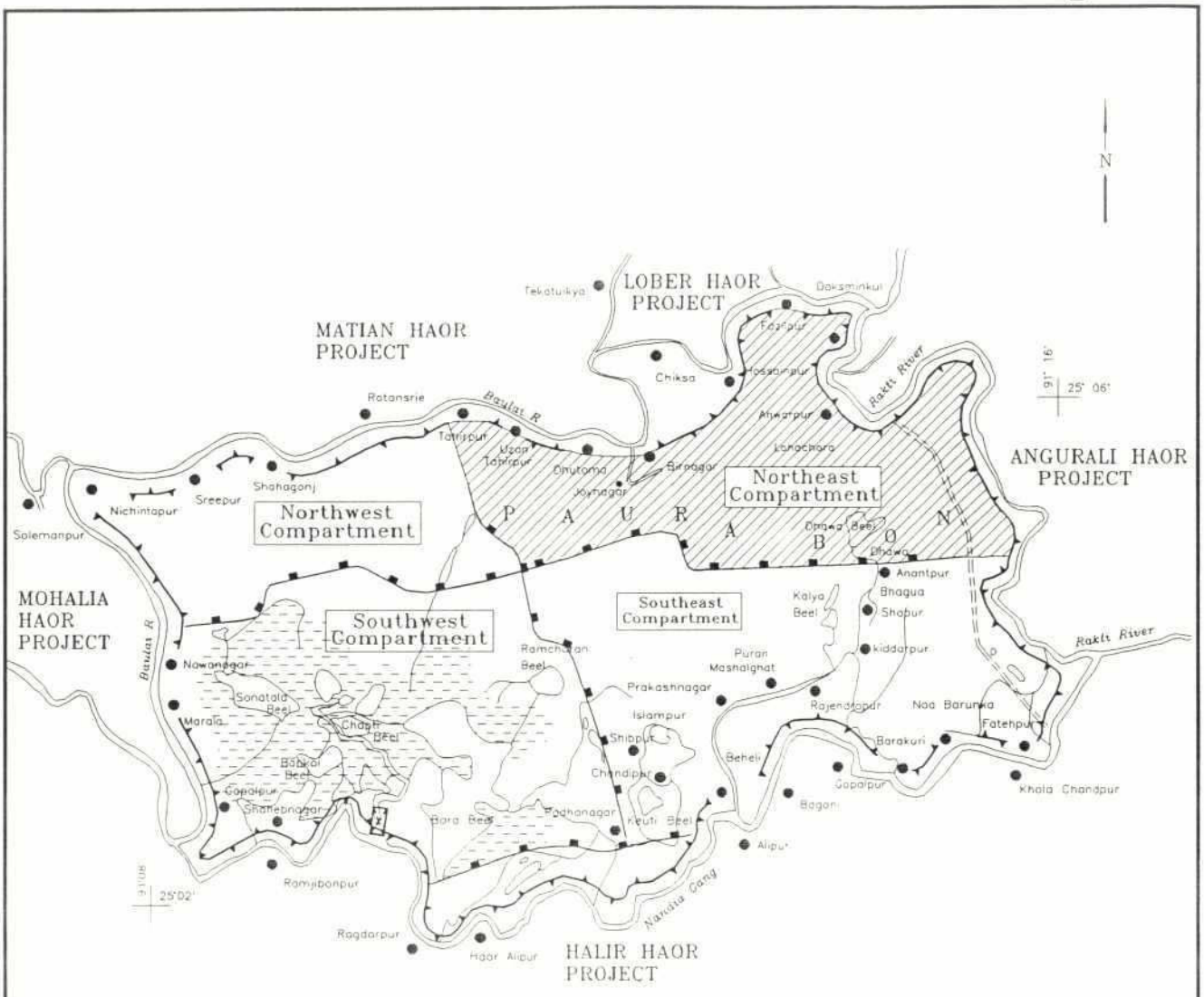


Northeast Regional Project

Shanir Haor Project
Layout of Hydraulic Structures

Prepared by: Michael E. Ibbitt	March 1994
Drawn by: Mamun	AutaCAD Drawing

Figure 6



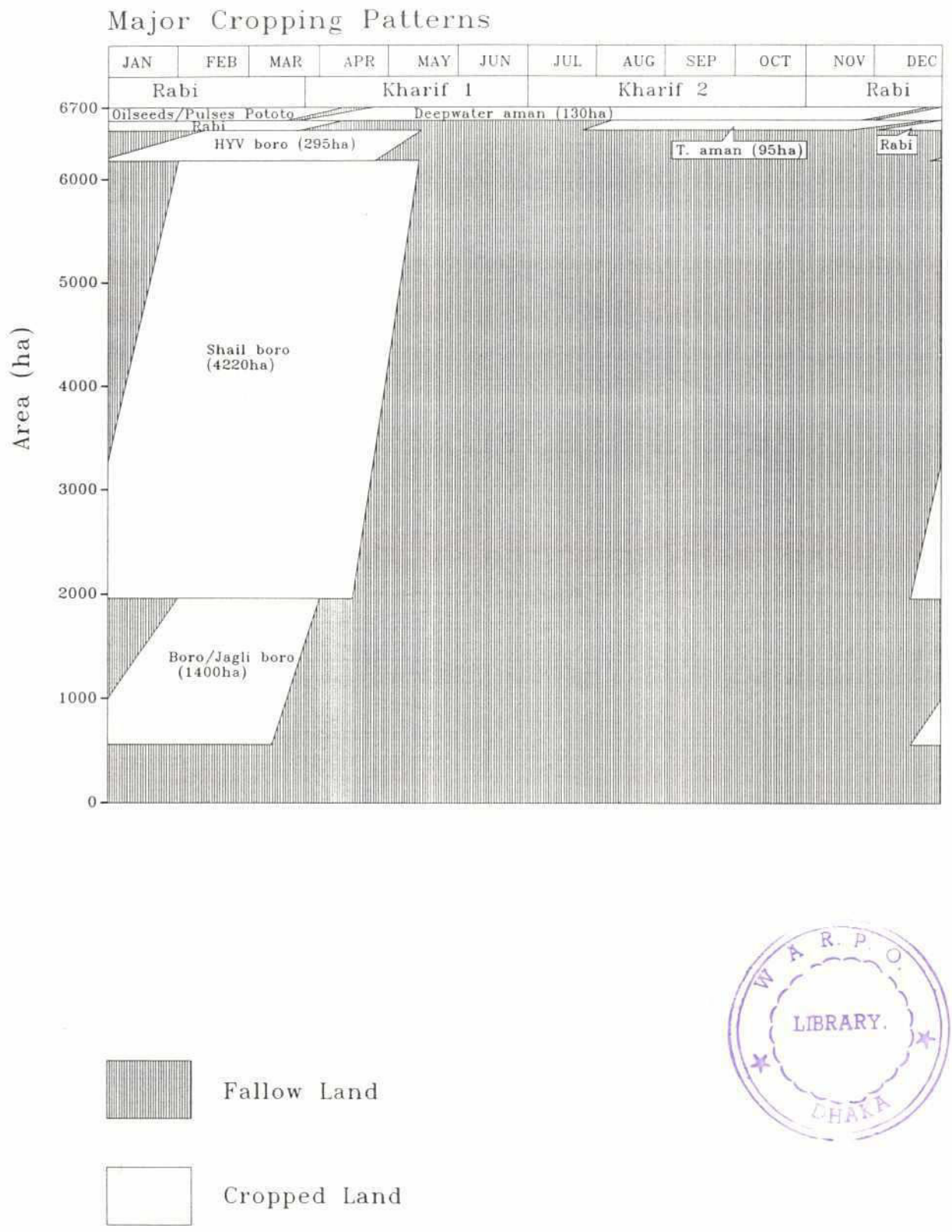
Northeast Regional Project

Different Compartments of Shanir Haor Project

Prepared by: BNP/Mamun | April 1993

FILE: FISH-66.DWG

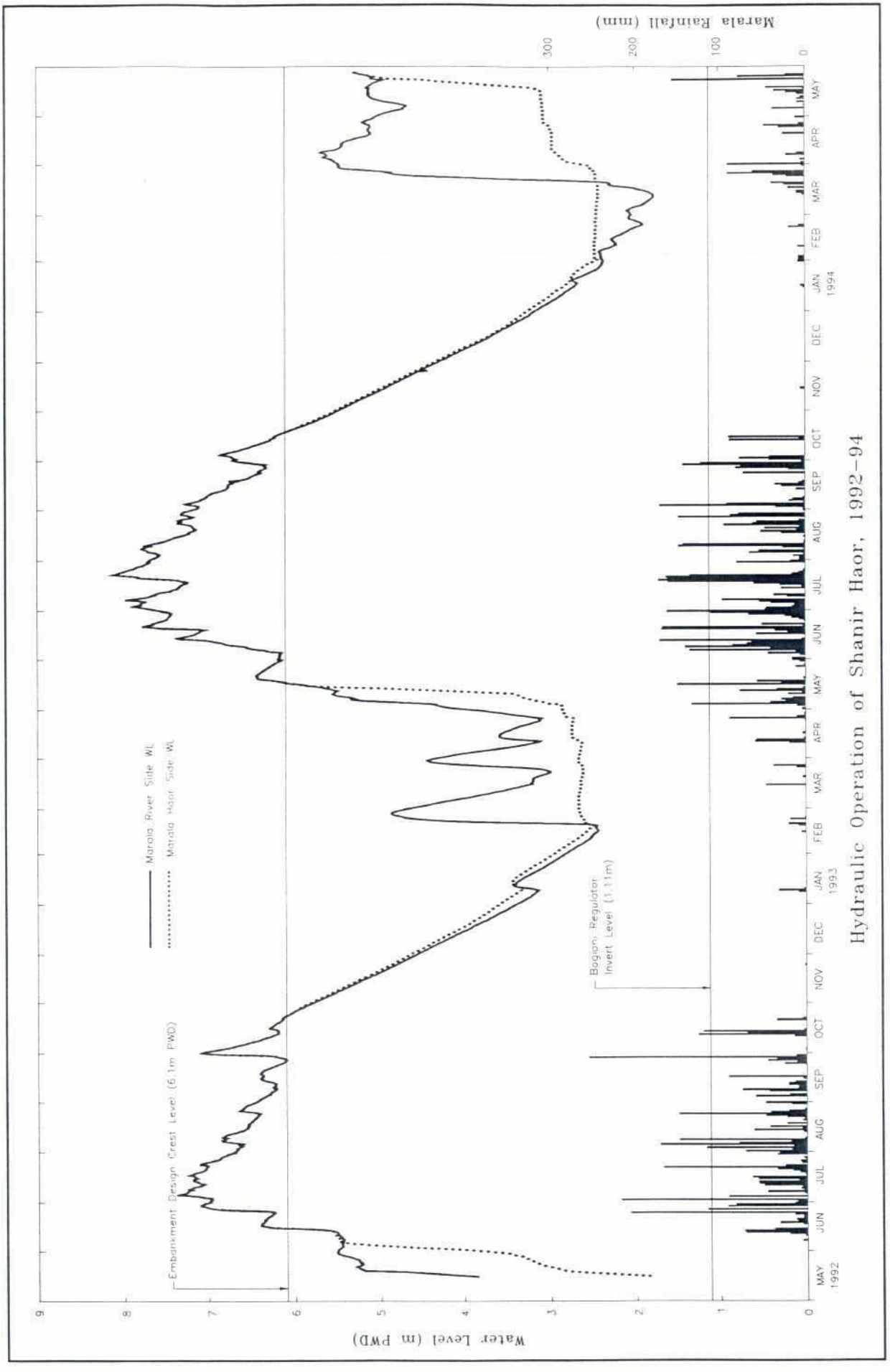
Figure 7



MAJOR CROPPING PATTERNS

FILE: NERP-851.DWG

Figure 8



Hydraulic Operation of Shanir Haor, 1992–94

Figure 9

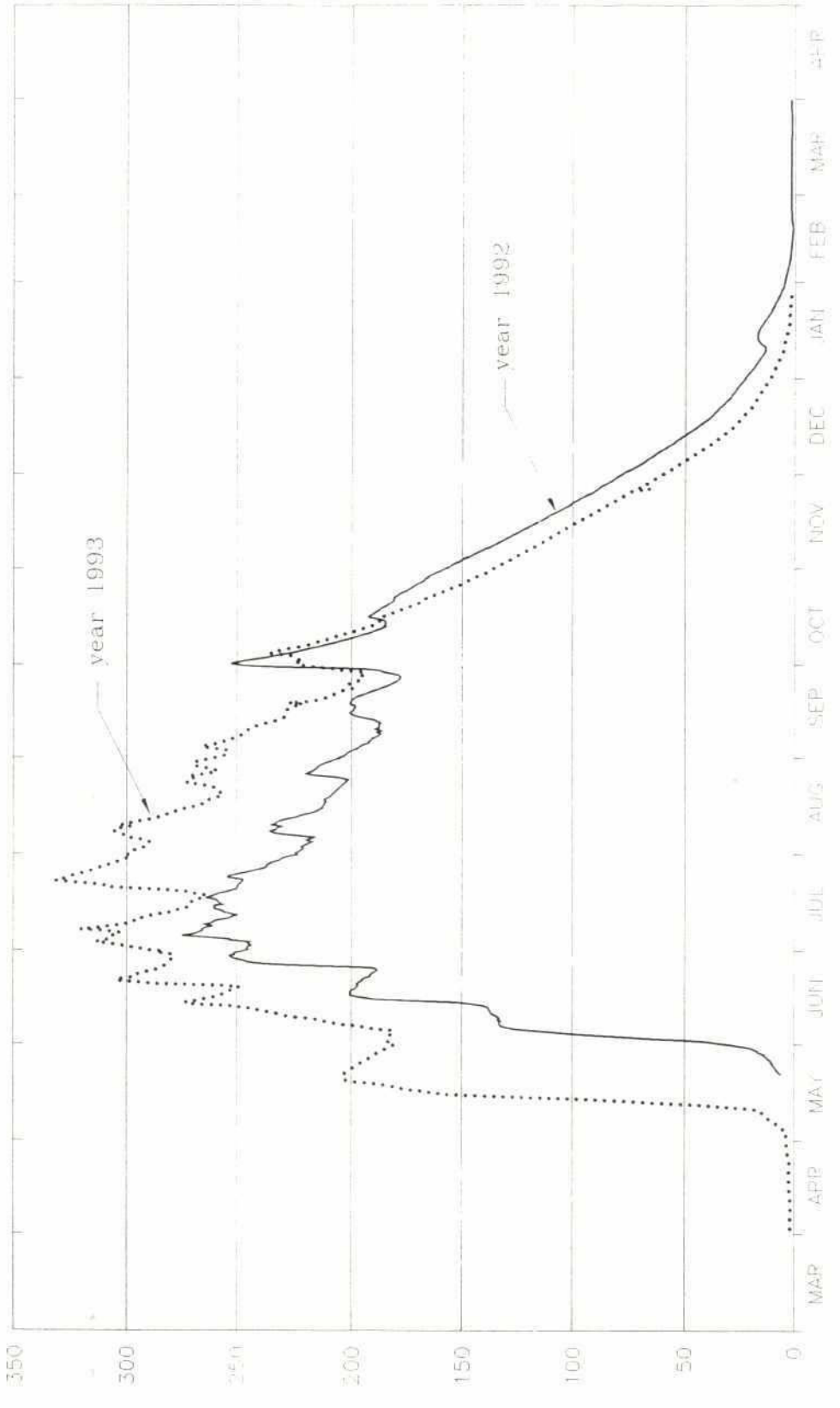
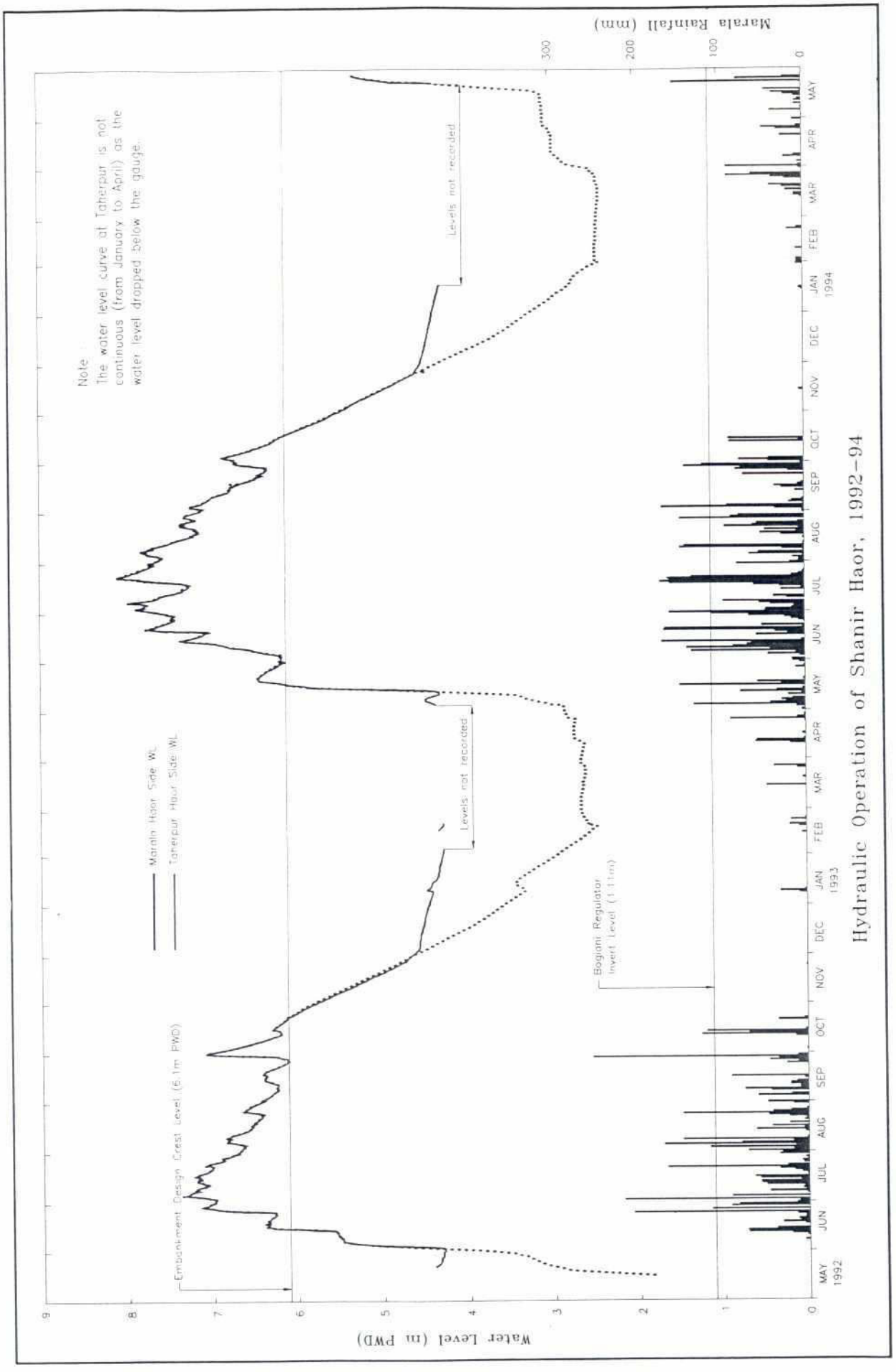
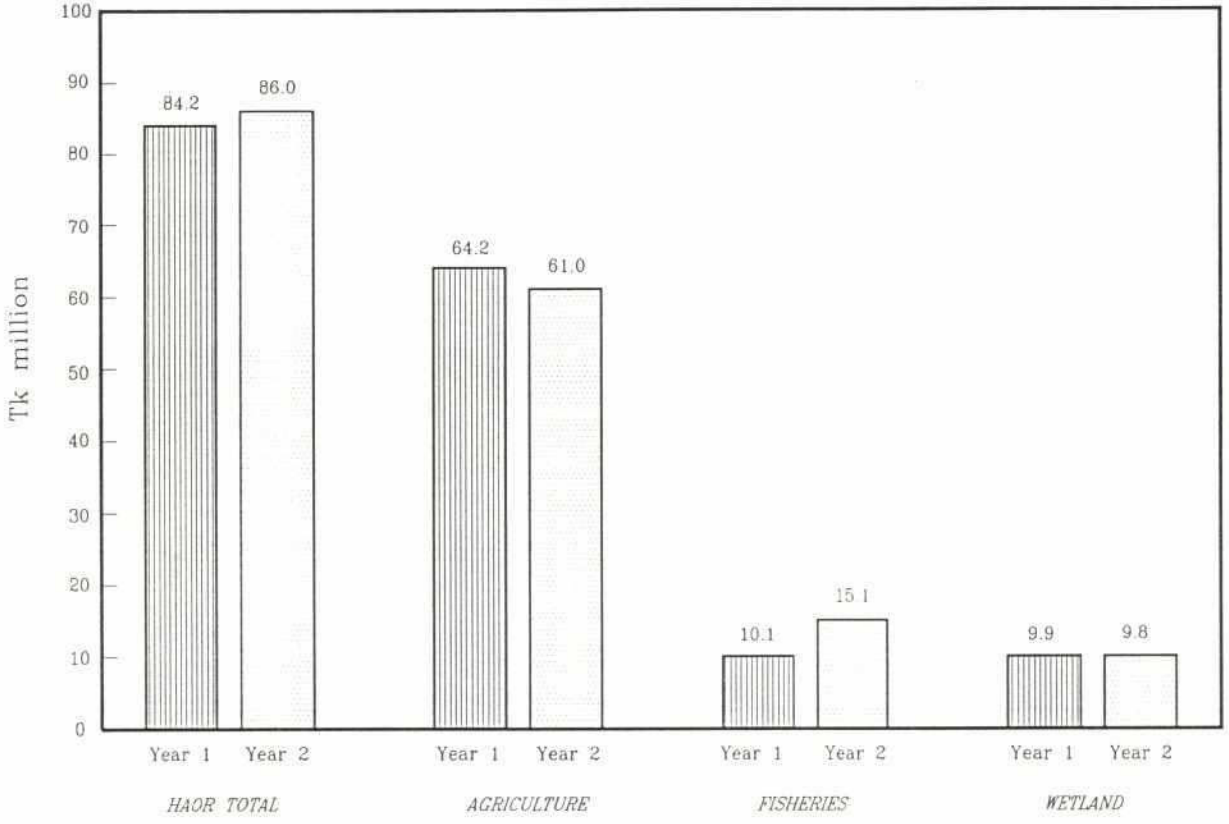

Hydraulic Operation of Shamir Haor
Shamir Haor Lake Volume (MCM)
350
300
250
200
150
100
50
0
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
year 1992
year 1993

Figure 10

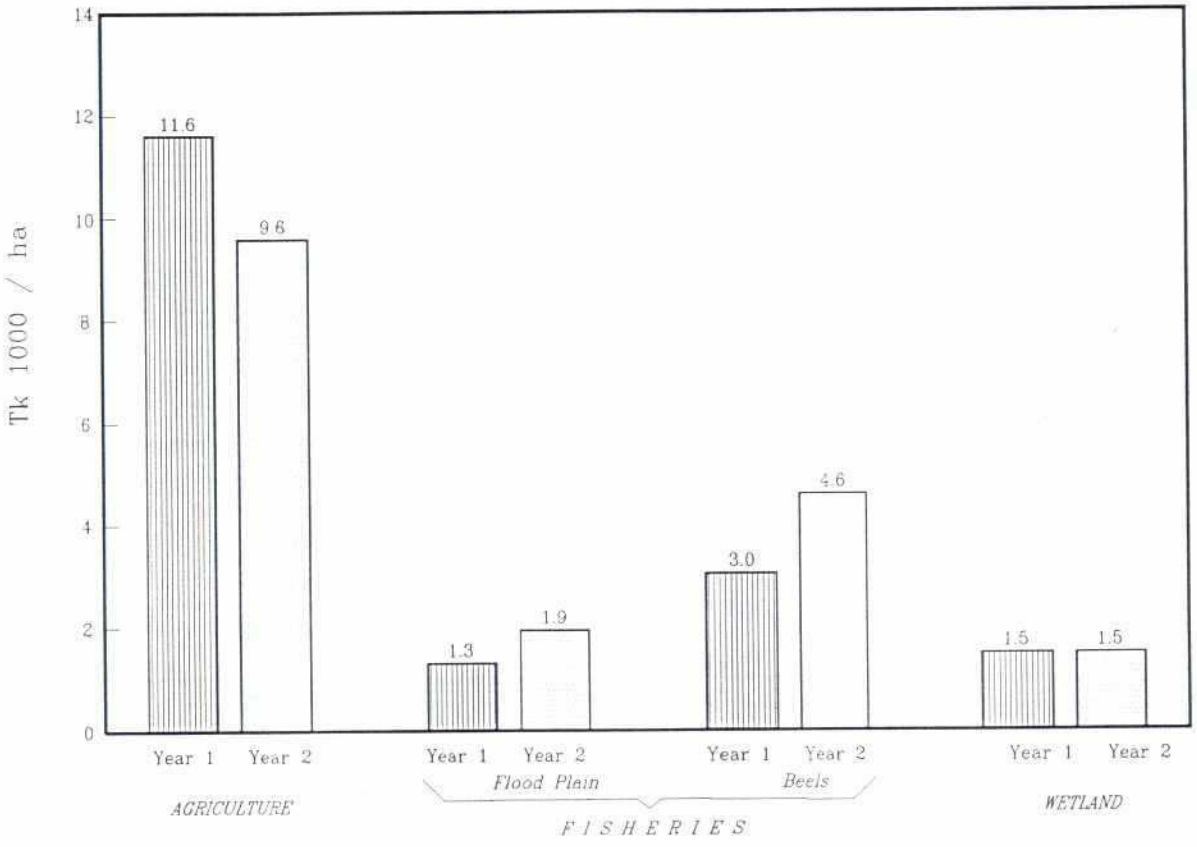


Hydraulic Operation of Shanir Haor, 1992–94

Figure 11

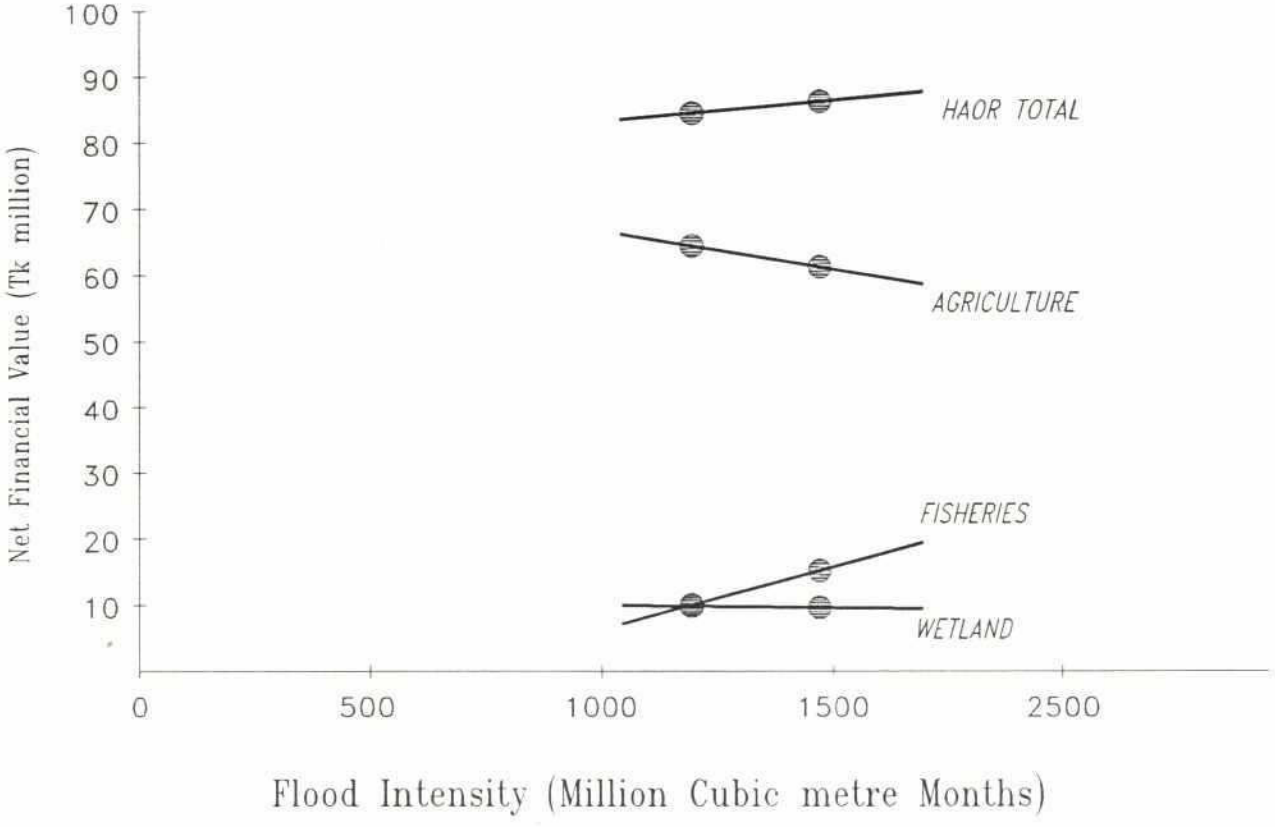


NET FINANCIAL VALUE
SHANIR HAOR FCD PROJECT



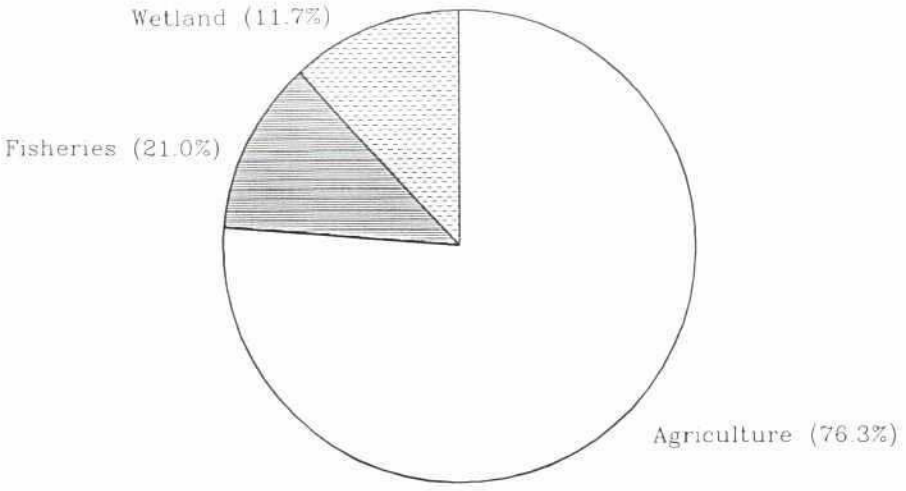
AVERAGE GROSS MARGINS PER HECTARE
SHANIR HAOR FCD PROJECT

Figure 13

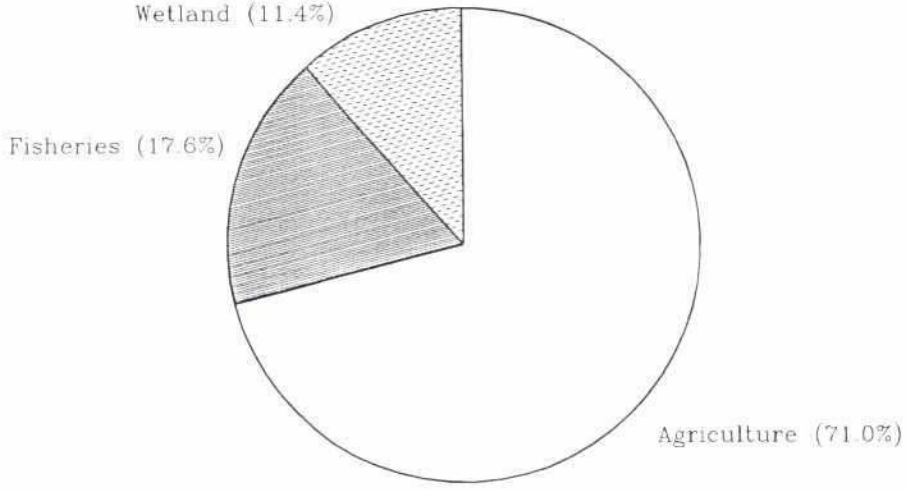


Shanir Haor FCD Project

Figure 14



YEAR 1



YEAR 2

Comparision of relative contribution of three primary sectors to total net financial output values of Shanir Haor FCD Project